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Editorial

SCIENTIFIC WOMANPOWER

THE consequences of the national mobilization effort for the future of scientific training and research in America present a grave problem. However wisely the question of the drafting of male science students and young scientists into the army may be solved (several proposals for its solution, prepared by government agencies and professional societies, were reported in the December issue of the *Bulletin*), inevitably, a few years hence, the supply of trained scientific and technical manpower in America will be markedly reduced. The building-up of an army of unprecedented size will reduce the college enrolment; universal military training, which is likely to be enacted sooner or later, will postpone by one or two years the age at which new scientists will become available for professional work. The depletion of the ranks of science teachers and research leaders by the growing demands of military research will affect the quality of scientific education in the colleges and direct the research training of young scientists into applied fields.

It is only realistic to prepare now, not for a passing emergency, but for a protracted state of full mobilization, probably accompanied by actual fighting in different parts of the world. Analyzing the possible developments without smugness, Americans must face the distinct possibility that they may find themselves outnumbered not only in fighting men, but also—if Western Europe should be lost as an ally—in scientists and technicians. Our national policy at present is to prevent this great calamity; but the ultimate success of this policy will, at best, remain uncertain for several years. To be prepared to meet the worst, it will not be enough to secure the continuation of a trickle of male high school graduates (augmented by a few veterans and men refused by draft boards because of physical unfitness) into the science and engineering departments and medical schools of our universities. Rather, the apparently insoluble dilemma will have to be solved—how to maintain the training of young scientists, doctors, and engineers, at least at its present level, quantitatively as well as qualitatively—and, at the same time, build an armed force of a size unprecedented in this country except in times of all-out war—an army, which will require men of technical skills and high intelligence, in numbers unheard of in the past. To make the solution more difficult, it will have to be found in the face of an inevitable (and understandable) pressure of public and congressional opinion to stop "coddling the intellectuals" and put an end to the "luxury" of scientific education and research activity "as usual."

* * *

There is in this country one—and only one—large reservoir of potential scientific, medical, and engineering "manpower," which is as yet almost entirely untapped: the American women. During World War II, American women in large numbers were employed in war industries; sizable contingents joined the armed forces as useful auxiliary units. With the renewed swelling of production and the growing demand for the reduction of the disproportionate number of men in the rear echelons of American fighting units, this development is likely to repeat itself. World War II did not witness, however, any spectacular increase in the enrolment of women in the scientific, medical, and technical departments of American colleges; and no sign of such a development is visible now. In this respect, America is far behind the nations of Europe, in particular, the Soviet Union. Even before the revolution, the proportion of women in the medical profession was much higher in Russia than it is now in the United States; dentistry was considered as a "woman's profession." Since 1917, Russian women have invaded all fields of technology; during the war of 1941–45, they supplied the greater proportion of students in all departments including not only science and medicine but also engineering; and they have not been significantly displaced from these professional fields since the end of the war. In America, women doctors and scientists are few, women dentists almost unheard of, and women engineers practically nonexistent. The millions of girls that enter American colleges every year proceed to study languages, literature, art, "home economics," psychology, or the social sciences; even in these fields, only few of them continue their study into the graduate years.

Conflicting opinions can be held as to the relative capabilities of men and women as scientists, doctors, and engineers. It is not our purpose here to argue for or against any of them. Even in Russia, after thirty years of equal opportunity for professional activity, considerably fewer women than men occupy front-rank positions in academic science or industrial engineering. We are concerned, however, not with top achievements or positions of leadership, but with the innumerable jobs to be done in hospitals, laboratories, and industrial shops—jobs which Russian women have been holding down satisfactorily, and which American women, given a fair chance and encouragement, could carry out with the same success.

* * *

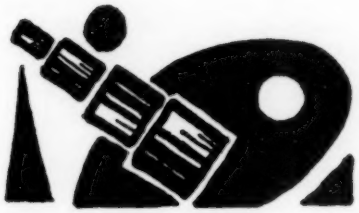
Leaders in American education—particularly women's education—and officials responsible for the planning of long-range mobilization of American manpower, would be guilty of a fateful omission if they did not consider, at the present time, the necessity of bringing about a radical change in the accustomed American attitude toward the study of science, medicine, and engineering by women. The time to direct thousands of girls who graduate from high schools into these fields of study, is *now*.

This is one of the few steps that can be taken to relieve radically the shortage of technically trained personnel that is likely to face America four to six years from now, even if Congress and the armed forces were to show the highest wisdom and understanding in permitting men students in science

(*Continued on page 37*)

SCIENCE AND THE FEDERAL GOVERNMENT

LOUIS N. RIDENOUR



In the mobilization of our scientific manpower, what part can the senior scientist usefully take? One answer to this question is given by a physicist who has left his university post for two years of government service. Dr. Ridenour is at present on leave from the University of Illinois, where he is professor of physics and dean of the Graduate School, to serve as special assistant to the Secretary of the Air Force.

IN THESE remarks, I shall avoid any discussion of the moral issues involved in pursuing military research and development, because I sincerely believe that those issues do not exist. Science can affect only the logistics, and not the morality, of war. Atomic explosives, about which one hears so many moral preachments, have indeed made a dramatic and sudden change in the logistics of warfare. Yet it is difficult to see the moral distinction between an old-time thousand-plane bomb raid and its military equivalent, the delivery by one aircraft of one atomic bomb. From the moral standpoint, it seems to me, the two types of attack are identical in intention, their expected results are the same, and they must therefore be viewed as equivalent.

Of course, there is valid ground for apprehension in the power and scope of the destructive weapons which advancing technology has put into our hands and into those of our potential enemies. Man's inhumanity to man can now be implemented in dreadfully effective ways, and in ways not dreamed of only a few short years ago. Our apprehensions should, however, not center on the relative morality of killing men rapidly and cheaply, as compared with killing them more slowly and laboriously and at greater cost. They should focus instead on the real problem: the problem of averting full-scale war while we work to establish a world of lasting peace.

This nation has undertaken two major tasks which must be carried on simultaneously. The first task is that of maintaining sufficient military power to make it impossible for the enemies of the free world to extend their dominion without the threat of effective opposition. The second task is that of taking political and economic action which will convince the world that peaceful solutions can be found for the problems which beset mankind.

Together, these tasks present the greatest and most complex challenge which has faced this nation since its birth.

Neither of these tasks has a fixed and durable solution, which needs only be found and applied in order to solve the problem. Instead, both are dynamic. We cannot build the latter-day analogue of the Maginot Line and then retire behind it, confident that our military problems are in hand. Neither can we chart permanent solutions for our economic and political problems. Instead, we must constantly press forward with a flexible, ever improving approach to the problems of effective armed readiness and effective participation in social organization.

It is precisely because these problems are dynamic, and not static, that modern science is so crucially important to the nation. Our military superiority must be a technological superiority, for in respect of sheer numbers of men the free world may be inferior to those who would oppose it. Our ability to master the complexities of modern economic and political problems rests importantly on tools of analysis and communication with which advancing science is providing us.

Thus, the sometimes-heard cry for a moratorium on physical science, so that social science can catch up, is not only wrong-headed but actually dangerous to our social institutions themselves. Science is the shield of democracy, in a very real and immediate sense.

FEDERAL SUPPORT OF SCIENCE

Aware of this, the federal government is putting an unparalleled amount of the national effort into the support of scientific research and development. There are three general patterns of federal participation in such support.

The first is that involving the direct support by the government of a laboratory or scientific establishment. There is nothing new in this, of course; the National Bureau of Standards, for example, dates from the first decade of this century, and the Naval Research Laboratory has been in existence since the First World War. What is new is the scale of effort involved. The military departments alone maintain well over fifty identifiable research and development facilities, the total investment in plant being roughly a billion dollars, and the total number of employees over fifty thousand.

The second way in which the government supports scientific activity is through the device of research grants or contracts to academic institutions or industrial establishments. The detailed fashion in which this is done varies widely from one government agency to another. In agriculture, federal funds are appropriated directly to agricultural experiment stations maintained in the land-grant institutions. The military departments make research and

An address given before the Atomic Scientists of Chicago on November 24, 1950.

development contracts; the U.S. Public Health Service makes grants-in-aid of research; and so on. All told, this federal support of scientific research and development costs the government over one billion dollars annually.

Finally, various government agencies have been authorized to engage in fellowship programs which support the advanced training of promising students of science. Currently, 23,000 graduate students are being educated in various institutions on federal fellowships, the total cost of the program being about $16 million.

I have recited these well-known matters simply to point up the fact that our government is not only a large-scale participant in the national scientific community, but is the largest. This degree of support of science implies, inevitably, a corresponding degree of control of science by the federal government. Whether we like it or not, the tempo and the emphasis and the general climate of scientific research in this country are being set in Washington, by actions of the Congress and by decisions and policies of the responsible government administrators.

ADMINISTRATIVE PROBLEMS IN THE PROGRAM

The government, more so than industrial organizations and academic institutions, is constantly faced with complex problems in the administration of its research and development activities. For example, the problem of secrecy in science has been a particularly thorny one. Everyone knows of incidents in which the entirely justifiable concern of the government for preserving the security of vital information concerning new weapons has led to specific individual acts which seem unreasonable, to say the least.

At the same time, we can appreciate the magnitude of the problem which faces our government agencies charged with the task of internal security. It is evident that the individual follies committed in the name of security, which we scientists are accustomed to recount to one another with disdain, are, in fact, committed in good faith by well-intentioned men whose only shortcoming is an unfamiliarity with the scope, the methods, and the content of science. We, ourselves, are in the best position to repair this lack; have we done so?

Another matter which has involved lengthy negotiations between civilian institutions and the government is that of contract terms. It has taken five years to arrive at a reasonably uniform and satisfactory pattern for a research contract between such an agency as one of the military departments and a university contractor. The principal difficulties have centered around educating the military contract people as to the difference between a research contract and a procurement contract, and around the problem of preserving to the contractor those freedoms of investigation and of publication without which a university cannot work. Here again, ignorance of the nature of science is the fundamental cause of the fact that the government carries on its activities as patron of science in something less than an ideal way. Here again, many of us know the problems, but how many of us have taken part in helping to solve them?

THE ROLE OF THE SCIENTIST IN THE ADMINISTRATION OF THE GOVERNMENT PROGRAM

Of course, many scientists from industry and from the universities have done what they can, on a part-time consulting basis, to help the government meet its responsibilities adequately and well. The Air Force has a high-level Scientific Advisory Board, and this Board has made and is making important contributions to the technical progress of the Air Force. Many other government agencies seek and obtain the help of civilian consultants.

However, let us bear in mind the absolutely vital importance of the full-time people who are charged with the administration of the scientific activities of the federal government. Even with the best part-time advisors, it is perfectly possible for an organization to do an inferior job if its full-time staff is inferior. Everyone knows the relative importance, to an industrial concern or to a university, of the Board of Trustees and of the president. Unless the president is competent, the whole operation suffers, while a competent president can often do a good job in spite of a mediocre Board of Trustees.

Our government is keenly aware of this. In an effort to attract good men into government service, top professional grades have been established in the Civil Service at salaries which compete fairly well with top university salaries, though they are still far below top industrial salaries for key scientists and technical executives. Yet there has been considerable difficulty in manning these important government positions with technical men whose stature and abilities correspond with the importance of the posts.

To quote from the Report of the Study for the Ford Foundation: "Our government agencies lack an adequate share of the nation's more competent technicians and administrators. Many conditions now discourage such persons from entering government service. Among these are the level of pay; the lack of sufficient opportunity to do challenging work and to develop individual initiative and abilities; and the abuse, suspicion, or lack of prestige which is so often the reward of men in public service."

Most scientists are thoroughly familiar with these difficulties surrounding active government service. Complicated governmental machinery does sometimes appear to hamper real accomplishment. In most cases involving scientists, pay need be no real obstacle to an individual who desires to render public service, but financial sacrifice is not uncommon.

Despite these difficulties, I think that the time has come for the national scientific community to take its proper part in the administration of national scientific affairs. We are facing an uncertain future of limited warfare and unlimited resistance to communist aggression. We must insure that our country remains in the forefront of technical progress. We cannot do this by part-time service on advisory boards and committees, however important such advisory activities may be. Neither can we do it by the erection of a special *ad hoc* agency for the cultivation of military research and development, to be activated when everyone agrees that a dangerous state of emergency has been reached. We are faced with a continuing situation in which the long-term performance of our government in scientific research and development is crucial to the continued existence of democratic institutions. We can make an adequate contribution in this situation only by taking actual part in the full-time work of established governmental agencies that are concerned with scientific matters.

This is important to science, for the fundamental policies affecting science are increasingly fixed by the federal government.

This is important to the nation, for the wisdom and effectiveness with which the immense program of government-supported science is administered will vitally affect the future of the country.

This is important to the free world, for our resistance to communist aggression is primarily based on a technological superiority which we cannot maintain without the highest possible level of continuing technical achievement.

We cannot sufficiently improve the government's performance in the scientific fields by criticizing and advising from outside. We can do so only by taking the responsibility for what the federal government does with respect to science, and offering our own services to help do it. The temptation to stay home, to continue doing useful work in a comfortable academic or industrial environment, is strong. Yet it must be conquered, and I think it can be.

One of the ways of increasing one's personal effectiveness while rendering public service is to be free of the necessity of relying on a permanent government job for financial security. Because of this, we find in the government service large numbers of men with independent financial means. Most scientists do not have means which make them independent in this way. Yet they usually have a bulwark which is just as good: an excellent job with every prospect of continuing tenure. This may be either a stable industrial position or a professorship at a sound university.

Under present world conditions, it would seem reasonable to ask of the physicist that he be willing to spend, say, two years of every ten in direct government employment. This should be done on the basis of leave without pay for the institution employing him. Tenure, retirement arrangements, and insurance should be unaffected by such periods of leave. There is every indication that the institutions concerned are willing to make such arrangements, even in connection with their most able staff members. The real problem is the willingness of the individual to interrupt his career in this fashion.

Yet, in the present situation, can the individual afford to do less? Our nation is attempting to steer the perilous course between appeasement and preventive war. It is maintaining the difficult balance between national power and individual freedom. Of central importance is the free world's performance in science and technology, for the situation is a dynamic and ever changing one.

THE PROPER USE OF POWER

General Vandenberg, the Chief of Staff of the United States Air Force, recently gave a speech that I found the most compelling and most inspiring statement of our problems I have ever heard. He pointed out that between distant international agreement and desperate resolve on inevitable all-out war lies the difficult middle way of averting full-scale war by power, and of removing the causes of war by diplomacy. Here is General Vandenberg's prescription for the proper use of power:

"If we are to use power not only to safeguard ourselves but to safeguard freedom and minimize the danger of eventual war, then we must:

"Exercise power with such boldness that we weaken the purposes of our enemies;

"Exercise power with such foresight that we strengthen the resolve of our friends;

"Exercise power with such judiciousness that we do not squander our resources;

"Exercise power with such prudence that we do not derange our political life;

"Exercise power with such strength that no enemy shall miscalculate our resolution;

"Exercise power with such constancy that our friends need never doubt us."

The point of quoting this here, apart from the elegance of the rhetoric, is that science and scientists are responsible for putting into the hands of our nation the power that General Vandenberg is speaking of. Our military power rests fundamentally on the foundation of our scientific achievement. Our scientific achievement increasingly rests on the competence of our federal government in its management and cultivation of science. This competence cannot be what the nation wants and needs unless competent scientists take part in seeking it.

Science is the shield of the free world, and our scientists are the custodians of science. Is it too much to ask that they take part, as needed, in the mobilization of science for the defense of the free world? Here lies the fundamental responsibility of the scientist in the world of today.

Editorial: Scientific Womanpower

(*Continued from page 34*)

and technology to complete their education.

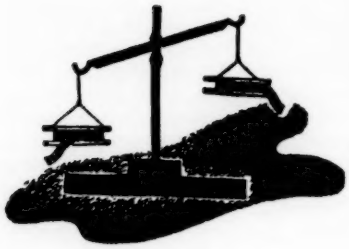
In the past, the anticipated difficulty of meeting male competition in professional careers has discouraged many young women and their parents from assuming the burden of expense required for a complete course of study in science, medicine, or engineering.

Considerations of this kind must not be permitted to affect the decision of qualified high school graduates at the present critical time. The probable duration of the crisis is such that it is likely to offer future college graduates in science, medicine, or technology, a considerable number of years of professional employment, irrespective of sex. There is a fair chance that if and when this period ends, colleges, hospitals, and industrial laboratories will have become accustomed to women employees, and will give those who have proved their capabilities a fair chance to continue their professional life. If necessary, to overcome reluctance, government should enter the picture, and offer an aid program to reduce the financial risk a woman takes in embarking on four or more years of study in science, medicine, or engineering—by offering scholarships, or educational loans to be repaid as a percentage of professional earnings after graduation.

—E. R.

THE STOCKPILING AND RATIONING OF SCIENTIFIC MANPOWER

HENRY D. SMYTH



The December issue of the Bulletin contained proposals on the mobilization of scientists, prepared by several government advisory groups. The following recommendations on this subject come from Professor Smyth, formerly chairman of the Physics Department at Princeton University, now the one scientist-member of the U.S. Atomic Energy Commission.

ON DECEMBER 16 the President declared a state of national emergency. Such a declaration, and the facts behind it, naturally influence all our present thoughts and plans. Some of us are filled with emotion and can think only in terms of immediate action. This is not good enough. Regardless of the outcome of the situation in Korea, this country now faces the necessity of planning not only for the coming months but for the coming decade and the decade after that. We may not have to fight a full-scale war. We profoundly hope that we shall not. But we know now that we must prepare to resist aggression with all our strength for the foreseeable future. We shall have to increase greatly the armed forces of this country, using our material resources and our manpower in the wisest possible way. In every aspect of civilian life the first concern of each citizen must be the long-range value to the country of what he is doing. In the period ahead of us, no citizen can be deferred from national service in this sense.

It is not good enough to boast that we will fight for freedom. We must think for freedom, and this is much harder. As we prepare for possible war, we shall inevitably have to delegate increasing authority over our lives and actions to the national government. At the same time we must be vigilant to maintain our fundamental rights of independent thinking, criticism, and free discussion.

THE DANGERS WE FACE

It has become clear that our survival is at stake. Not just our material survival, but our survival as a society of free men and women. If our cities are destroyed, we can rebuild them. Our spiritual destruction would be still more fearful. It is not numbers, nor buildings, nor wealth, that make a people great. It is their freedom and their vigor. We might lose our freedom; we might even lose our passion for it. This could happen through armed attack and conquest by our enemies, or it could happen from our own stupidity and short-sightedness. If we are forced into a major war, we must remember that armed victory is only a means to an end and that the years after the war gauge the reality of victory. If the methods we use to win a military victory should destroy our moral position in the world, or our own self-respect, or change our free society into a totalitarian one, we shall not have won the war. On the other hand, if our hatred of war and our desire for peace lead us into the acceptance of an alien and barbaric conqueror, we shall have lost more completely. We shall then have given up our freedom and be the serfs of a police state imposed by men who neither understand nor respect the ideals that have made us great. These dangers are real and must be faced squarely. I believe we shall overcome them.

A third danger remains. We may be drawn into a war for which we are not adequately prepared, and we may fight it less skilfully than it needs to be fought. It is to one phase of this specific danger that I want to address myself today.

An address given before the annual meeting of the American Association for the Advancement of Science, Cleveland, Ohio, on December 28.

SCIENTISTS AS TOOLS OF WAR

Men of science, traditionally peaceful, internationally minded, and nonpolitical have become a major war asset. It is important that they be used to the greatest advantage. I believe that we are facing dangers so great as to make the comfort and convenience of any group trivial in comparison to the contribution such a group can make to our survival. For that reason, I have chosen a somewhat grim title for this paper—"The Stockpiling and Rationing of Scientific Manpower." For that reason, I am speaking of scientists not as men who enrich our culture but as tools of war needed for the preservation of our freedom. I hope you will understand why I am willing to consider the group to which I belong in this objective and impersonal way.

TWENTY YEARS OF TENSION

To plan the stockpiling and rationing of any war commodity requires some assumption about timing. If we are discussing how scientists can be used most effectively as tools of war, we must ask when such a war will be fought. This is a question Americans cannot answer with any exactness, for we will not be the aggressors. But it is now clear that if the free society of the West is to survive, we must be prepared to meet at any time a large-scale attack upon us or upon our allies. It may come soon, or it may not come for years. In considering scientific manpower as a major war asset of this country, I assume a twenty-year period of tension with the possibility of major or minor wars occurring at any time in that period. This is indeed long-range planning, but the events of the last five years have forced it upon us. We must now face these realities with courage and intelligence.

NATURE OF TOTAL WAR

The forces involved in a future war will be as important as timing. In every war this country has fought for the last hundred years, we have been able to crush our enemies by sheer weight of numbers and materiel. It is unlikely that we can do so again. In any future war we shall probably be outnumbered, and by men who are physically tougher than we are. Our natural resources may be no greater than those of our enemies. We may be fighting with much longer and more vulnerable lines of communication. We shall win only by being cooler, cleverer, and more skilful than our enemies, and by using the resources at our command with foresight and judgment. We must understand the nature of modern total war. Every citizen will be involved in it, whether he is in or out of uniform. We must get over the idea that men in uniform are automatically more valuable than the same men in civilian clothes. The men in uniform may be in greater danger, though even this is doubtful in view of the large number who are never in combat and the probable dangers to a civilian population in a future war. Each man's usefulness should be the sole criterion of his value to his country.

USE OF SCIENTISTS IN PREPARATION FOR WAR

On these assumptions as to the timing and nature of a possible war, how shall we best use our scientific manpower? First of all, let me say what I mean by scientists. For purposes of this discussion, I mean men who have had at least some graduate study (or equivalent experience) in the physical or natural sciences. This definition arbitrarily excludes most medical men and engineers, although much of this discussion applies to them also. Of course their value is comparable, but the problem of their use differs enough in detail to require separate treatment which I will not attempt at this time.

Based upon our experiences in World War II, I believe we can say that science contributes to our effectiveness in war and preparation for war at six levels. First of all, scientists are needed to provide fundamental knowledge, adding to our basic understanding of the laws of nature. In World War II, for the first time in history, we pushed our development of weapons close to the limit of our basic knowledge. Discoveries in science less than five years old were put to use in the atomic bomb and in other weapons. This may happen again, but only if there is new knowledge to put to use. Basic research is so near the forefront of knowledge that no specific use can be foreseen for any part of it, nor can it be specifically directed. But if there is doubt in anyone's mind about the military value of work of this sort, it could be set at rest by the Atomic Energy Commission. If secrecy permitted, I could cite examples of postwar research in basic science that have already been put to use in our weapons program.

The second level where science is essential is intermediate between what is clearly basic research and what is clearly development. At this level, possible utility is borne in mind in a general way and may dictate a choice of field but not a choice of problem. An example of this level is the study of certain areas of organic chemistry by chemists working for a plastics company or the study of ferro-magnetism by the physicists of the telephone company.

A third level of scientific usefulness is in applied research where a specific question is posed and an answer sought. The development involved may be that of a new chemical process, a new material, or a new weapon, but it is always to meet a specific need.

The last stage in development work and a fourth scientific level is the testing of prototypes under field conditions and the work of getting into production. The amount of labor and ingenuity required in this last stage is often very great and the cost correspondingly so.

Once new weapons are produced, they must have operators. Generally speaking, scientists are rarely required as operators, but experience in World War II proved that they were needed to instruct operators. They were also needed to inspect the actual use being made of weapons in the field so as to understand weaknesses which should be corrected and to explain the capacities of the weapons to their military users. This work constitutes the fifth level where scientists are valuable.

Finally, but of great significance for a prolonged crisis, we must have new scientists educated. The education of a new generation of scientists cannot be done quickly. They must have a minimum of four years' special training, and, in many cases, ten to fifteen years of training and experience. To produce such men we must continue to have teachers and universities.

NEITHER BUSINESS AS USUAL NOR WAR AS USUAL

These are the jobs we have to do—all of them necessary if the country is to excel in the techniques and weapons of modern war over the next twenty years. All these levels of work have been carried on during the last five years of peace. In the period now facing us, we can expect only to shift the emphasis or increase the effort, or both. Some peacetime activities can perhaps be curtailed. These are most likely to be found in the middle of the spectrum that ranges from basic research to weapons development. For example, work on improvements of nonessential industrial products or processes certainly could be curtailed. On the other hand, applied research on weapons or on industrial processes bearing on weapon production needs to be accelerated. Vast sums of money will be available to the services for research and development. I hope this money will not be squandered on doing things in triplicate or on hiring able scientists for pet projects that have little bearing on either science or war. Money does not create brains, nor the expenditure of millions of dollars alter the laws of nature. Our ignorance of these laws is still so great even in advanced fields like nuclear physics that basic research must go on. On the time scale I have suggested, our success in basic research is necessary to our survival.

All this adds up to slight curtailment and considerable expansion. It may sound as if I were recommending business as usual. I am suggesting that we cannot have war as usual. We cannot win another war by a mere outpouring of men and resources. We can only beat our enemies by being much brighter, much shrewder, much cooler, and more farsighted than they are. We must use our weapons and men more skilfully than they. In particular, scientific men are important because the novelty and effectiveness of our weapons depends on them. If we are to expand our scientific efforts, we must examine closely our stockpile of scientific manpower.

PRESENT SCIENTIFIC MANPOWER

Have we the scientific men we need? If not, can we get them, and how can we best use them? I could quote to you statistics that have been gathered by many painstaking studies in the last few years. These statistics show we do not have the men we need. But the lack is obvious even

without statistics. We trained almost no scientists between 1941 and 1946; and since 1941 needs have developed like that of the Atomic Energy Commission, which now employs directly or through contractors as many physicists as there were in the whole country in 1920. The lack is also obvious to anyone who has recently been trying to hire first-class senior scientists. Therefore, I will omit statistics at the risk of being considered unscientific by those who believe numbers less fallible than words.

Can we do anything in this period of emergency about the shortage of scientific personnel for war work? As I have suggested, some diversion from present industry is possible. For example, I will venture to single out two areas that might supply scientists. I suggest that most of the chemists from the cosmetics industry and most of the physicists from the television industry could have their abilities used in ways that would be more likely to insure the survival of this Republic. In such industries as these, a fair number of qualified senior scientists could be found and a considerably larger number of men who could work under direction.

Yet it is clear that taking men from industry will do little or nothing to strengthen the basic research which will continue to be vital. Nor will it furnish very many senior men capable of directing bold and imaginative work in weapons research itself. Evidently, there is such a shortage that each man must be used wisely and more men must be trained in science by holding many students and teachers in universities.

The problem then is clear and has two parts. First, to use the scientists we have as effectively as possible; second, to train more. Before making some suggestions for the solution of these problems, it may be well to review how we tried to meet them between 1940 and 1945.

EXPERIENCE IN WORLD WAR II

Dealing first with the question of use, let us recall what happened during World War II. It is easy to say that we misused our scientific talent in that war. I hardly think that is a fair statement, but certainly better use could have been made of it. Among the older men, recruitment for various projects was usually carried out by a kind of chain letter system. The initial group brought in men they knew. These new men brought in their friends, their former students, or other scientific acquaintances, and so on. Had the supply been unlimited, this would have been an excellent system. In practice, however, different projects soon came into collision so that individuals had to choose between offers from different laboratories, without having the necessary information to make the choice wisely. Not infrequently the advice of the top people in the Office of Scientific Research and Development had to be sought. Except in so far as it was counteracted by OSRD, this system tended to strengthen projects that had started early and were already strong. Vested interests were built up, and it was difficult to man new projects or to deflate projects when they had essentially completed their missions.

This system also had the disadvantage of stripping men from universities and stopping basic research almost completely. Quite apart from the removal of students by the draft, it was psychologically almost impossible for a man to continue basic research, since there was no one to tell him it was important, and the recruiting officers of every war research project were continually telling him it was not. In the scientific community, the last war began in the summer or fall of 1940, but full mobilization was not reached until sometime in 1942 and lasted only about three years. Nevertheless, its effects on training and basic research were very serious. In the period of sustained tension that may now be facing us, effects of the kind I have mentioned could be disastrous.

I have been referring to the scientists who were used as civilians in various war laboratories of the OSRD or the services, men who were above draft age or whose deferment was relatively easy to obtain. For the younger men, the situation was much more unsatisfactory. Either they were deferred by a process often painful and temporary or they went into the services.

When young scientific men were drafted or volunteered, they became enmeshed in a system designed to train and use men for combat. This is no place for me to discuss the wisdom of using military uniforms and ranks for the many jobs a modern war organization has, in which the work to be done is much more like civilian work than it is like fighting. I can only say that a research laboratory is probably the most inappropriate place in the world to have military organization. Fortunately, ordinary common sense usually came into play in laboratories such as Los Alamos, where there was a large detachment of soldiers who were more familiar with slide rules than guns. The men were given positions and responsibilities determined by their scientific qualifications regardless of their scale of pay, or the color of their suits, or buttons. This is one reason our war laboratories produced results.

In general, the services did try to use men of scientific background in places where their training was appropriate, but there were many cases where such men were entirely wasted and many more where they could have been used more effectively. The Selective Service System was not designed with this objective in mind and could hardly be expected to function successfully.

On the whole, we can find little satisfaction in the methods of using scientists of any age in World War II. As for stockpiling, it practically stopped. Almost no new scientific men were trained between 1940 and 1945. In preparing for a possible future war, we must do better.

DANGER OF REGIMENTATION

When one tries to work out solutions of this scientific manpower problem, one immediately runs into a contradiction. It is a contradiction inherent in the nature of a free society and perhaps accentuated in the particular section of society made up of scientific men. Free men cannot be treated like inanimate tools. They will do their best work if they retain initiative and responsibility, and this is particularly true of men doing scientific research. We cannot have completely centralized government control of science without losing much of the strength we are trying to preserve. At the same time, the country has a right to expect that young scientists of military age will be as much at the command of their government as other young men of the same age. If we are to avoid the mistakes of the last war, we must propose a positive kind of service to replace the policy of deferment for young men in scientific work. No course of action to accomplish this

will seem attractive to men used to complete freedom of choice, for science—like other fruitful products of men's minds—has known its best fulfilment in the free atmosphere of peace. But today we face a possible struggle for survival, and so our first concern as scientists must be to ask how we can serve this country, and to accept whatever plan seems to fulfil that purpose. The suggestions I shall put forward are not original with me, but I am responsible for the form in which I present them.

PROPOSAL FOR A SCIENTIFIC SERVICE CORPS

I propose the establishment of a Scientific Service Corps directed by a Scientific Manpower Board and based on a national roster of scientists. These organizations would be concerned only with scientists who have completed their education, not with students. Nevertheless, two categories are concerned; men of military age, normally subject to call for military service, and older scientists. Both categories would be under the general supervision of the Scientific Manpower Board, and both would be listed in the roster. At present, only the scientists of military age would be required to join the Scientific Service Corps, and only the members of this corps would be subject to orders from the Scientific Manpower Board. For older scientists the board would act in an advisory capacity only.

This Scientific Service Corps would be a civilian organization without ranks or uniforms. I believe it would be most effective if it were guided by that curious mixture of cooperation and discipline that characterizes most civilian organizations in this country. The principal function of the board in charge would be to get the right man in the right job, and often this man's own judgment should carry great weight. The Scientific Manpower Board, although a civilian organization, would need to have real authority over the members of the Service Corps. It would need power to keep them out of the army, navy or air force, or to put them in. It should have power to return men from military to civilian service or vice versa, or to shift them from one project to another, or to return them to universities. But I hope that most of the orders issued by this board would be merely formal endorsements of voluntary agreements. Cooperation will serve us better than force.

For scientists not in the Service Corps, the Scientific Manpower Board would act only in an advisory capacity. With information on the full scope of national defense research projects, it could be an invaluable guide for men who wanted to be sure they were making the best use of their abilities.

The Scientific Manpower Board should be responsible to the President, not to the Department of Defense. The quality, wisdom and powers of this board would be the key to the success or failure of the whole scheme. Its ideal should be guided cooperation with the scientists, not rigidly organized direction of them. The board members and staff would require access to complete information on all technical and scientific phases of our military activities and of the supporting civilian economy. They would also have to know the scientific community —not just the names and numbers in a card file, but the men themselves. This suggests the need for regional branches of the board.

STUDENTS

Turning to the question of stockpiling, that is, the training of new scientists, we have quite a different problem. Various schemes have been proposed for the deferment of students. Most such schemes do not make it clear that we are aiming at a positive goal, not a negative one. We are not interested in helping individuals escape the duty of military service just because they are bright boys or happen to have played with chemistry sets as children. We are interested in developing a group of men with trained minds and disciplined imaginations who can strengthen the country over the next twenty years. That some of them will be doing very nearly what they would choose to do in peacetime is irrelevant except in so far as it may make them more effective.

Can we not have something more positive than draft deferment for brilliant students of science, medicine, and engineering? The continuance of their education in such times as these implies obligation, not privilege. I propose a Student Scientific Corps with enrolment beginning in the freshman year and continuing through graduate training. The requirements of native intelligence and industry in such a student corps would be high and the requirements of sustained performance higher still. Students who did not keep up would be continually weeded out. Men of excellent technical competence but lacking in imagination and originality would be carried only through their undergraduate training and then released to the armed services or to industry. Others would be continued through graduate training. Some recruits should occasionally be added to the Student Corps from the services or industry or project research to receive more education.

Administration of this Student Scientific Corps should be, it seems to me, decentralized as much as possible. Professors in the universities would be best fitted to take the responsibility of making judgments within the established criteria. No amount of statistical data, intelligence tests, or examinations can replace the intimate knowledge a university professor should have of his good students. The Student Scientific Corps or training program, or whatever it is called, should perhaps be under the general jurisdiction of the National Science Foundation. Cooperation with the Scientific Manpower Board and with Selective Service would be essential, but the problems are sufficiently great and sufficiently different to suggest separate authorities.

EFFECTS OF UNIVERSAL MILITARY SERVICE

Although the programs I have discussed are intended to meet both short-range and long-range requirements for scientific manpower and are not meant to be dependent on the present system of recruiting under the Selective Service Act, they may appear in conflict with other proposed systems of recruiting for the armed services. One such system is the plan to put all eighteen-year-old men into military service. It is estimated that if these men were kept in service for two years, the country would have a total of three million men constantly under arms and would shortly build up a large trained reserve. Once their period of service was over, these men could feel confident that they could pursue their education and begin their professional careers without interruption unless large-scale war broke out.

The first effect of this proposal on the training of young scientists appears to be bad. All men now eighteen would defer their education two years, with a corresponding interruption in the supply of engineers and scientists four to eight years later. To some degree these effects could be counteracted by acceleration or by special training of men still in service or by reduction of the length of service for

obviously talented men. On the good side would be the smaller probability of interruption for men already started on their professional careers. In the long run, that is, the ten- or twenty-year period I have been talking about, these effects would largely disappear, with one exception: the dozen or so students of really outstanding brilliance who appear each year—and there are seldom more—might be lost to science or have their early and most productive years spoiled.

There is another danger. The young men who had been in service might be kept in some sort of reserve; in fact, they should be, or much of the point of their military service would be lost. However, they constitute a whole generation of manpower, the manpower that is needed for the innumerable civilian activities as essential to success in total war as the army or navy or air force. It would be wise to put the control of this reserve manpower in civilian hands at the highest level.

As to the use of mature scientific manpower, this 18–20 service proposal seems to have only secondary effects. It might relieve the pressure for direct military service on some of the younger scientists. In the long run, it might help stabilize the universities. It does not remove the need of a Scientific Manpower Board, a Scientific Service Corps, or a Student Corps. While I believe the Scientific Manpower Board should be vested with great authority from the first, the proposed military service for eighteen-year-olds might lessen the danger of too hasty and too arbitrary exercise of that authority.

SUMMARY AND CONCLUSION

I have tried to put before you the problems of stockpiling scientific manpower and rationing it, in the best interest of the country, just as we would any other essential resource. I have proposed for this purpose a Student Scientific Corps to insure a continuing supply of scientists. For men of military age, I have proposed a Scientific Service Corps to be directed by a Scientific Manpower Board. For men above the age of military service, I have suggested widespread voluntary cooperation with the Scientific Manpower Board.

These may not be the best solutions to this problem, but they are possible ones. Any system to be established must obviously be flexible and subject to change with experience and with changing international conditions. Either the organization I have suggested, or a better one, should be set up now before we repeat the errors of the last war.

I believe there is real danger that nothing will be done, or that a system will be set up and will fail. Scientists can best understand the nature of this danger. They know very well that a thoughtless bureaucracy with centralized control can threaten the independence, imagination, and clarity of mind needed for creative work. Scientists know also that a haphazard system of recruitment can lessen their value to the country. I suggest that scientists throughout the country have a peculiar duty to work for the adoption of a sensible system for the wise use of scientific manpower, to talk to their friends of the need for such a system, and to make such a system work. They know what needs to be done. I urge them to give the foresight and leadership to achieve it.

Such questions as these cannot be left entirely to the government. They are everybody's business. What John Curran said in 1790 is still true:

"It is the common fate of the indolent to see their rights become a prey to the active. The condition upon which God hath given liberty to man is eternal vigilance; which condition if he break, servitude is at once the consequence of his crime and the punishment of his guilt."

SCIENTIFIC MANPOWER MOBILIZATION

The Defense Department's proposal for universal military service was presented to a Senate subcommittee on January 10 by Secretary Marshall and Assistant Secretary Rosenberg. On January 18 the plan was sent to Congress in legislative form. The plan includes provisions for continuing the training of a limited number of technical students. The following report on the proposals appeared in the *Washington Post's* January 11 coverage of Mrs. Rosenberg's press conference.

"Pointing out that the present Selective Service Act permits the call of men aged 19 through 25 with dependents, Mrs. Rosenberg said if Congress fails to extend the draft to 18-year-olds, the present administrative deferment of husbands and fathers must be dropped.

" 'It is perfectly apparent,' she stated, 'that such a draft of husbands and fathers would be much more destructive in its family and community consequences than the calling of 18-year-olds on a universal basis. . . . The domestic, financial, and emotional shock to the young man of 18 is far less acute to all concerned than the uprooting of an older family man. The same thing is true of the impact on business, science, education, and the life of the community generally.'

"After completing their 27 months active service, youths would go into the National Guard or Reserves for from three to six years service. The plan thus would serve a double purpose—take care of the needs of the regular armed forces and provide a flow of trained men into the reserve components.

"Here is the way the educational deferments of 18-year-olds would work under the program:

"1. A limited number of youths—perhaps 35,000 to 50,000 of those reaching 18 each year—would be selected for ROTC courses in colleges while taking their four months basic training. After completing their college courses—which would be partially subsidized by the government—the men would be commissioned as officers and have to serve 47 months active service—their remaining 23 months draft obligation plus the 24 months service now required of subsidized ROTC students.

(*Continued on page 64*)

COMMENTS ON THE MILITARY VALUE OF THE ATOM

J. ROBERT OPPENHEIMER

Dr. Oppenheimer was the wartime director of the Los Alamos Laboratory. He is now director of the Institute for Advanced Study at Princeton University.

WHAT contribution may one reasonably hope that the atom can make to our military power, the power for the prevention of war, the limitation of war, and for the defeat of the enemy in the event that war does come? It is clear that not all the aspects of this problem are public or can be public. What is important is that there are some aspects that are public.

In the past the debate about the military value of the atom has had a singularly empty quality. To the first impression that the atomic weapon was so great a thing that it was a decisive, an absolute military power, there was a reaction: it is another weapon, it is "just another weapon," or, as in Mr. Hoover's phrase, it is "a less dominant weapon" than we had thought. People close to the work have at times also thought that the atom was a bit of a gold brick. But, in fact, one cannot talk in these terms. This is the argument of the optimist who thinks that this is the best of all possible worlds, and of the pessimist, who knows it. This is not an argument that has meaning.

For our purposes, at this time, there is a very definite thing we need to say: the difficulty and the magnitude of the military and the political problems which we now face and will continue to face, and the extent of our investment in the atomic field, mean that we cannot afford to misuse, and we cannot afford to ignore, what the atom can do for military purposes. This is a luxury in which we should not indulge.

In what I shall say, I am limiting myself, and I think rightly limiting myself, to one use only of atomic energy, one class of uses, the atomic bomb. There have been many references in the papers to other projects: to poisons, to other kinds of explosives, to propulsion systems for military craft of one kind and another. That is enough to indicate that some technical work has been done on them. But it is not of them I am speaking, but of the Atomic Bomb.

There are two sides to our problem, though they are related. One side is the technical and the military: questions of what we do to make weapons available, what weapons we make available, how we plan to use them; the other is the side of policy, the conditions under which we might use atomic weapons, their significance in the conduct of war, their significance in international relations. It is clear that these two sides are related; and yet it will be useful, I think, to separate them; for the role of the public is quite different in them.

THE TECHNICAL QUESTIONS

With regard to the first group of questions, the technical ones, technical both for engineers and scientists and for the military people, the public role is probably in the first instance to determine that secrecy and power are not being abused, that the right questions are being asked and that reasonably honest men are trying to answer them. There is a lot of hard work to do, much of which has not been completely done at the moment. There is, as the commission has made clear, an increase in the scale on which the explosives are to be manufactured. That will not be a trivial undertaking; for there is not only a problem of a balance of the various ways of making explosives, but of a balance between them and other military efforts, a necessarily tight balance in a period of mobilization. The use of electric power and the use of other scarce materials are examples.

There is an obvious need for the development of weapons systems, so that one can use atomic bombs in a variety of ways, so that one can deliver them in more than one way, and so that one can make them for a variety of targets and uses and situations. There is need for operational planning, so that one may be prepared to anticipate under what conditions they are good weapons, and a good use of explosive, and under what conditions they are not; and there is need for serious work on such countermeasures as exist. There are no special countermeasures against atomic weapons; but if we can intercept carriers, we can hope to intercept carriers of atomic bombs.

These are all major problems. They are not substantially different from those which are met in all other branches of the mobilization program. There is a bit of novelty; and there is one important difference: there is a very great lack of military experience. It is doubtful whether the military experience of the end of the last war is relevant, and, in any case, it applies only to a special form of delivery and a special target, a high altitude delivery of atomic bombs against cities. Nevertheless, I am quite confident that good work on all four of these points is being done, that more and better work will be done, and that, with vigilance and sense, we shall come out with a very considerable increase in military capability.

QUESTIONS OF POLICY

The other side, the policy side, is the one where the role of the public is rather different and rather deeper. That is, of course, also partly a technical question, because one cannot ask whether to use, or under what conditions to use, or how to regard a weap-

Excerpt from an address given before a meeting of the Association of the Bar of the City of New York on January 11.

on, until the weapon is defined. It is also a technical question, in that normally and properly these decisions are made by the chiefs of staff, by the National Security Council, and by the President, and not by a Gallup Poll. But I think I am right in saying that public opinion on the use of atomic weapons is a most important factor. I have been so assured by many military planners. Even without that assurance, it is obvious, if only because how we use and whether we use atomic weapons in warfare depends a great deal on what else is done. It depends a great deal on whether the public insists upon, supports, or balks at other military or political measures.

The question comes first, of course, in the crude form: Shall we or shall we not use the atomic bomb? I think that before public debate can usefully cope with the question, it is necessary to have a few distinctions. One of them is this: We normally think not of the weapon, but of the specific use which was made of it against Hiroshima and Nagasaki. We think of it as an instrument of strategic bombing, for the destruction of lives and of plants, essentially in cities. It is the decisive, even if perhaps not the final, step in a development that may have started at Guernica, that was characterized by the blitz against London, by the British raids on Hamburg, by our fire raids on Tokyo, and by Hiroshima.

STRATEGIC BOMBING

In so far as the prospect of such use may be a deterrent to the initiation of war, or an inducement to governments to carry out policies which we think are sound, and in our interest, it is a fine thing. But the question arises: What happens if the fighting starts? What sort of an instrument is this in a real war? At a time when so very much of our uncommitted military power is in the form of atomic weapons, it is a question that it is dangerous not to face. It is not a new question. It has been asked before. I have thought that I could do little better than to quote comment on strategic bombing from the hearings[1] held in October of 1949, before the Armed Services Committee of the House, in connection with the so-called B-36 program. In those hearings, there were many debates about whether the B-36 could ever reach its target, and many debates about whether, if it did, the bombardier could hit the target. From time to time the argument took on a more general character. Here are some fragments of the testimony of Admiral Ralph A. Ofstie, who is now in a Pacific command, who was at that time a member of the Military Liaison Committee to the Atomic Energy Commission.

Admiral Ofstie first said what he meant by strategic bombing. "There is no official definition of the term 'strategic bombing!' The official military term is 'strategic air warfare,' defined as: Air combat and supporting operations designed to effect, through the systematic application of force to a collective series of vital targets, the progressive destruction and disintegration of the enemy's war-making capacity to a point where he no longer retains the ability or the will to wage war. Vital targets may include key manufacturing systems, sources of raw material, critical material, stockpiles, power systems, transportation systems, communication facilities, concentrations of uncommitted elements of enemy armed forces, key agricultural areas, and other such target systems.

"This is a very broad field," he said. "Indeed, it would seem to be almost all-inclusive except for the active armed forces of an enemy. In fact, however, the major elements of most of those target systems are located where people live and work, in urban and industrial areas. Further to inject realism into the picture, we must view the tools with which it is proposed the job be done, in this instance the heavy bomber of very long range, of modest performance, operating at great altitudes, and preferably at night. These factors dictate area attack as the means of destroying war-making capacity located within those areas. Therefore, whether we speak of the mass bombing of World War II or the proposed atomic blitz of today, which are major tenets of the strategic bombing concept, we are talking of attacks on cities. This is what I mean when I use the colloquial term 'strategic bombing.'"

Then, speaking for himself and "many senior officers in the Navy," Admiral Ofstie says: "We consider that strategic air warfare, as practiced in the past and as proposed for the future, is militarily unsound and of limited effect, and is morally wrong, and is decidedly harmful to the stability of a postwar world."

After a technical summary of arguments on the degree of effectiveness, and the technical problems of executing strategic missions, Admiral Ofstie continues: "Much emphasis has been placed upon the instant character of an offensive using atomic bombs. Among laymen this has produced an illusion of power and even a kind of bomb-rattling-jingoism. Although responsible officials of the government generally do not themselves subscribe to it, they must be influenced by the public acceptance of the proposal of instant retaliation. The idea that it is within our power to inflict maximum damage upon the enemy in a short time without serious risk to ourselves creates the delusion that we are stronger than we actually are. This, in turn, becomes a constant temptation for policy-makers to over-commit themselves, to make commitments actually impossible to fulfil."

There is nothing in the public record which indicates that these views had at the time any great effect on military or political thought and planning.

TACTICAL USES

This was all long before the fighting broke out in Korea. Much of what was clear to Admiral Ofstie then has become clear to all of us today. The action in Korea, furthermore, has raised publicly another aspect of the question of the use of atomic weapons in warfare: their use against military targets. The targets commonly discussed are troop concentrations, airfields, naval craft, communications centers. These are among the targets that are an immediate military threat, rather than the basic producing power and the population of an enemy.

I am not qualified, and if I were qualified I would not be allowed, to give a detailed evaluation of the appropriateness of the use of atomic weapons against any or all such targets; but one thing is very clear: It is clear that they can be used only as adjuncts in a military campaign which has some other components, and whose purpose is a military victory. They are not primarily weapons of totality or terror, but weapons used to give combat forces help that they would other-

[1] House Committee on Armed Services, page 183.

wise lack. They are an integral part of military operations. Only when the atomic bomb is recognized as useful in so far as it is an integral part of military operations, will it really be of much help in the fighting of a war, rather than in warning all mankind to avert it.

Just in this connection, of course, it is clear that the mode of use and the time of use have a relation to each other. Today we do not have very much military strength with which to integrate atomic weapons. Two years from now that should be quite different.

The question of whether to use or not to use atomic weapons is a different question, depending on whether or not one has combat forces and is prepared for combat. They are always terrible weapons; they may not be effective weapons if they are all, or almost all, that we have.

THREE WAYS THE ATOM MAY SERVE MILITARY POWER

In fact, one can imagine, in some relation to time, at least three different ways in which the atom may serve as military power. The first and the easiest to imagine is as the principal, if not the only, instrument whose purpose is to destroy plant and kill people: that is the extreme form of the atomic bomb as a strategic weapon.

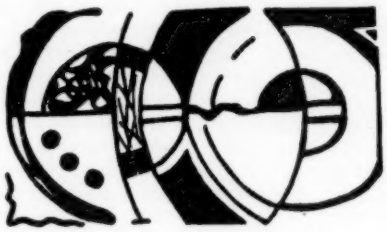
The second course is the use of atomic bombs primarily against military targets, in tactical use, in coordination with more conventional forms of warfare, in combat. Whether or not they would then be used strategically will depend in part on whether nonuse can serve as an effective deterrent; it will depend on the technical advantages, as they appear at the time, of offense and defense. It may not be reasonable to anticipate that the strategic use of atomic weapons will be renounced as was the strategic use of gas warfare, because, in any future we can foresee, the atomic bomb will offer far vaster prospects of destruction. Such renunciation could, I think, result only from a considered policy decision.

There is a third course we can imagine, that we need to imagine: that, with the obvious horror of a general war, through a combination of our efforts and the efforts of others, and through some good fortune, we may manage to find our way to a more secure and more tolerant and more open world without general war. It is as a principal deterrent to such war that the military power of atomic weapons may yet be decisive.

I am painfully aware that it is not entirely in our hands to determine which of these three courses does, in fact, take place, or which other course. I am also clear that it is not only or primarily a question of the atom bomb. But it is partly a question for the United States, and partly a public question; and it is partly a question of the atom. For if we misjudge what this weapon can or cannot do, in our hands or in the hands of the enemy, if we misjudge its contribution to military strength, it is clear that we will continue to cause our government, on the basis of our illusions, to follow a course whose only end must be disaster.

As you know, about a year ago the Prime Minister of India visited this country. He met with many people and talked with them; and shortly before he left the country I asked him whether he had found in his visit here any appreciation, in this quite different culture, of the Hindu notion of control, of restraint. He answered, "Since this, in the last analysis, only rests on a proper evaluation of the consequences of action, I cannot believe that any great people would be without it."

I believe that the American people are a great people.



DR. OPPENHEIMER ON THE RATE OF AMERICAN BOMB PRODUCTION

In his address before the New York Bar Association on January 11, Dr. Oppenheimer commented on the way his testimony before the Senate Committee on Atomic Energy has been misinterpreted as a basis for estimates of the size of the U.S. stockpile:

"For the last two years, I have seen many estimates of how many bombs we have, all allegedly deriving from testimony I gave about five years ago before the Special Senate Committee on Atomic Energy, estimates differing widely with the differing arithmetical practices of the reporter. Even in this last week I have heard and seen three such estimates.

"Let me quote the relevant excerpts of the testimony. Senator Tydings asked: 'Assuming that ten years from now atomic energy in many countries has been licensed by the government for peacetime manufacture and uses. . . . If it were decided to make military bombs from our peacetime atomic energy, how long would it take us to complete 200?' I said, 'Maybe a little over a year.' Senator Tydings said, 'How long would it take us to make 50?' And I said, 'Maybe a year.' And then I said, 'I think a year is too long; maybe nine months.'

"It is clear that these estimates concern the rate of conversion of fissionable material into weapons, whereas the pacing factor in the making of atomic weapons has for us been the making of fissionable material. Nevertheless, this testimony has been quoted and requoted as an estimate of our weapons stockpiles; perhaps unchallenged—certainly not adequately challenged—for many years."

THE TACTICAL USE OF THE ATOMIC BOMB

MAJOR GENERAL JAMES M. GAVIN

Since the beginning of the Korean war there has been much talk about whether the use of atomic bombs could conceivably influence the course of this campaign. On several occasions vague hints have been made that the bomb could be used not only as a mass destruction weapon against large centers of population or industrial installations in the rear of the enemy (which, at present, means in Manchuria or China proper) but also as a tactical support weapon for operation in the field. We reprint below, in a slightly shortened form, an article by Major General Gavin, which contains, to our knowledge, the only discussion by a prominent military expert of the possibility of tactical use of atomic weapons. From the statements of General Lawton Collins, it may be inferred that the views of Major General Gavin have not found acceptance by our highest military authorities—at least not in application to the Korean campaign as it has been fought to date. It is conceivable that the situation might present itself in a different light when, in the course of military operations, a very large concentration of enemy troops might be forced to assemble in a limited area—a situation such as might arise at the time of a decisive attack on a small defense perimeter. It has been pointed out in the editorial in the January issue of the Bulletin, and in the article by Dr. Oppenheimer in this issue, that the political and moral arguments concerning the use of atomic weapons have been based on the assumption that if atomic bombs were used at all, they would be employed on large centers of civilian population.

WE NOW have five years to look back upon our ideas and plans for the use of the newest weapon in our arsenal, the A-bomb.

Its first use was to destroy a Japanese city. Then followed the fanciful claims of what it would do. Typical of much public opinion were the ideas expressed by William Bradford Huie in the December 1948 issue of *Reader's Digest:* "We now have enough improved atomic weapons to immobilize the Russian nation . . . a staggering proportion of the inhabitants of Russia's key cities—millions of persons—can be killed or maimed in the first raid." Little thought seems to have been given to other possible uses. The mere threat of its use on urban and industrial areas was credited with maintaining the uneasy postwar peace.

Now, this exclusive acceptance of the bomb as a weapon of final decision when employed against the economy and the noncombatant elements of a nation's population is hard to understand. For never has a weapon been developed that is better suited for use against enemy combat forces.

The model T bomb (Hiroshima) packs a wallop of twenty thousand tons of TNT. But since it does not make effective use of all of its potential energy and it largely overkills, its actual destructive effect is closer to 1,300 tons. The relative effects of conventional bombing and atomic bombing are described in the report of the United States Strategic Bombing Survey:

"On the basis of the known destructiveness of various bombs computed from the war in Europe and the Pacific and from tests, the Survey has estimated the striking force that would have been necessary to achieve the same destruction at Hiroshima and Nagasaki. To cause physical damage equivalent to that caused by the atomic bombs, approximately 1,300 tons of bombs (one-fourth high explosives and three-fourths incendiaries) at Hiroshima and 600 tons (three-fourths high explosives and one-fourth incendiary) would have been required at Nagasaki—in the target area.

To place that many bombs in the target area, assuming light attacks under essentially the same conditions of weather and enemy opposition that prevailed when the atomic bombs were dropped, it is estimated that 1,600 tons of bombs would have to be dropped at Hiroshima and 900 tons at Nagasaki. To these bomb loads would have to be added a number of tons of antipersonnel fragmentation bombs to inflict comparable casualties. These would add about 500 tons at Hiroshima and 300 tons at Nagasaki. The total bomb loads would thus be 2,100 tons at Hiroshima and 1,200 tons at Nagasaki. With each plane carrying 10 tons, the attacking force required would have been 210 B-29's at Hiroshima and 120 B-29's at Nagasaki."

In addition to the blast and heat effects, nuclear radiation accompanying the explosion of an atomic bomb also causes casualities, some 15 per cent of the total.

VULNERABILITY OF COMBAT FORCES

The vulnerability of combat forces to atomic attack will vary greatly. It will depend upon how much they happen to be shielded by hills, buildings, trenches, and so on—and upon how far they are from the point of burst. We can readily conceive of land forces in dugouts and heavy fortifications that would give them almost complete protection from an explosion at two thousand feet altitude. On the other hand, land forces not dug in, and massed at night to force a river crossing, for example, might be completely destroyed by a well-placed atomic bomb. Massed aircraft on take-off airfields, and concentrations of shipping such as those off the Normandy beaches, would also be quite vulnerable. The vulnerability of each combatant in each set of conditions does not lend itself to exact definition. There is no doubt, however, that land combat forces moving in the offense or not well sheltered in defense would be prime targets.

Whether or not it would be worth to the enemy the expenditure of one or several bombs would depend upon the contribution of the destruction. One particular aspect should be noted: *lingering* radioactivity following an air burst at, say, two thousand feet, will not last more than a few minutes. In other words, highly mobile forces could at once attack into the area of the bomb detonation with reasonable immunity from radioactivity.

We are grateful to the editor of *Combat Forces Journal* for permission to reprint these portions of General Gavin's article.

Most veterans seeking a comparison from their own combat experience would describe an atomic-bomb attack as like the simultaneous detonation of hundreds of high-explosive and incendiary bombs. It would be concentrated in an area of three to five square miles and would be accompanied by intensive radioactivity. Compared with artillery, it would approximate a high density of well-mixed high explosive and incendiaries. Approximately eight thousand medium artillery shells per square mile, over a three- to five-square-mile area with a much heavier concentration in the center of the area than on the fringes, makes a reasonable comparison with the model T bomb. The intense fragmentation characteristic of artillery would of course be absent. This would be somewhat compensated for by radioactivity and objects sent flying by the blast.

SITUATIONS IN WORLD WAR II WHERE A-BOMBING WOULD HAVE BEEN TACTICALLY USEFUL

For further purposes of comparison, we can consider situations in World War II in which actual comparable tonnages of HE were delivered—actual battles in which heavy bombers gave direct tactical support to ground forces. There were many situations in which an atomic bomb could have been decisive. In addition to contributing decisively to the achievements of the army, its use could have saved many lives and much equipment.

Perhaps the best-known concentrated nonatomic attack of World War II is Cassino. The air force alone dropped 1,100 tons on Cassino in one attack. The defenders at Cassino were well dug in and protected. The attacking forces would have been much more vulnerable to atomic attack than the defenders.

In the Battle of Normandy, in July 1944, "carpet bombing" first found a place in the soldier's and airman's lexicon. The ground forces needed all air support they could possibly get when the critical breakout from the beachhead faced them. On July 24–25, 1944, the air force, using its heaviest bombers available in ETO, delivered 5,200 tons of bombs in ground support. They were dropped in an area of approximately 2,500 by 7,000 yards. This was equivalent to the destructive force of perhaps two atomic bombs. This was the Battle of St. Lô, a battle decisive in the larger Battle of Normandy. The performance of the air force's strategic bombers in this significant role contributed largely to gaining that decision. Ironically, the dispersed nature of the bombing caused the death of the army's foremost enthusiast for air-ground training and cooperation, Lieutenant General Lesley J. McNair. A more striking example of the need for close teamwork between the ground and air forces would be hard to find.

Iwo Jima is another example of a battle in which an atomic bomb could have been used to great tactical gain. Iwo Jima was a well-defended bastion directly astride the air route from Guam to Tokyo. In area, it compares closely to the destroyed area of Hiroshima. Its capture was costly—21,000 casualties, an escort carrier and an LCI sunk, major damage to 30 ships, and 168 aircraft lost.[1] How much less the battle cost and achievement would have been if an A-bomb could have been used, then followed immediately by air assault and air-landed forces.

Crete and Okinawa had much in common tactically. The capture of Crete was an essential preliminary to an assault on Suez.[2] The capture of Okinawa was the necessary first phase of our assault on Japan. Both islands had several good air strips and were well defended.

Crete was given a conventional softening up of high-explosive bombing followed by an airborne assault. It was a costly venture. The attacking Germans lost 12,000 men and 170 air transports, and in the words of the German commander, General Student, "it was the graveyard of German parachutists."

Okinawa's capture was just as important tactically. After the usual nonatomic softening up it was assaulted by amphibious forces. When the last shot was fired and the costs were tabulated, they amounted to 36 ships sunk, 368 ships damaged, 763 airplanes lost, and 48,025 casualties. A high price to pay for what one Marine called "a lousy piece of real estate."

In both battles a preliminary atomic bombing would have immeasurably aided the assault forces in establishing their initial lodgement. With an airborne assault following on the heels of an atomic bombing, and then an air-landed and amphibious build-up, their capture could have been achieved with comparatively small loss of life and combat equipment.

[1] USSBS (Pacific) Naval Analysis Division.

[2] Report of Interrogation of Generaloberst Student, October 1945.

World War II contains many other examples of engagements in which an A-bomb could have been used tactically with decisive results. Among those best known to our army are Anzio, Bastogne, Salerno, and Normandy.

COST OF ATOMIC BOMBS

Any consideration of the bomb's employment will take into account its cost. Actually its cost may be expressed in two ways—in actual intrinsic worth and its strategical and tactical worth. From the dollar viewpoint, Dr. J. R. Oppenheimer has estimated that its cost would run to about one million dollars. Tactically, however, the bomb may be given an entirely different value. For example, with a limited stockpile, it would be highly uneconomical to expend a hundred bombs for the purpose of destroying a ground division that costs a hundred million dollars, if there were other divisions available as replacements. But if a single bomb could render one division ineffective, it would probably be a worth-while one-bomb investment. Between these two extremes are many situations in which a bomb might be used to advantage. The chief military consideration must be this: What will its use mean in terms of battle decision at the time and place of its employment? The tactical or strategic gain achieved would usually be more important than the intrinsic worth of the bomb in any determination of whether it should be used. The airman must also weigh the cost of giving the needed ground support in terms of what it will cost to deliver it. The operational cost and losses in an attack by 150 to 200 medium bombers may be so high, compared to that of a few bombers escorting and carrying an A-bomb, that the A-bomb would most often be the better choice.

USE OF A-BOMB IN KOREA

For months one of the toughest battles in American history has been fought in Korea. Greatly outnumbered, and attacked by a foe that throws in masses of men and equipment regardless of losses, the U.N. forces in Korea tasted the bitterest experiences of war. The issue has been in doubt. But one aspect of the battle does seem clear. The United Nations land forces, using every weapon that can be got to them with our limited mobility, took heavy casualties. They shared a common battle achievement with their fellow combatants in the air force and the navy—

(*Continued on page 50*)

HOW CAN PRIVATE INDUSTRY BEST PARTICIPATE IN THE DEVELOPMENT OF ATOMIC ENERGY?

PHILIP SPORN

Mr. Sporn is president of the American Gas and Electric Service Corporation and is chairman of the Advisory Committee on Cooperation between the Electric Power Industry and the Atomic Energy Commission. He has served as consultant to the Monsanto Chemical Company at Oak Ridge on problems relating to nuclear power.

IT IS no secret that we have made little headway with the development of atomic power. No nuclear reactors are supplying any part of our power requirements, and there is no clear indication as to when they will commence to do so. I do not mean to say that that is a good thing, but there is no use quarreling with the facts as they are. On the contrary, I propose to ask why this is so.

A formidable array of technical obstacles stands in the way of getting ahead. Dr. Hafstad has recently catalogued these, and a mere glance at his list is enough to remind us how tough the technical job is.

It is with these problems that the National Atomic Laboratories have been preoccupied since 1945. Progress, perhaps much progress, has been made toward solutions, but until we reach the stage of pilot-plant trials, it will be impossible to assess the exact state of the art.

But the technical difficulties in the way of perfecting economical power-producing reactors are only a part of the problem.

Among the deep reasons why we are not further ahead is the fact that, relatively speaking, the state of power production and development by conventional means, particularly in this country, is unusually satisfactory. Thus in the United States, with less than 7 per cent of the world's population, we now produce more than 40 per cent of the world's electricity. In the period 1949 through 1952 we will have completed installation of new electric facilities to increase our total supply by close to 29,000,000 kw.—more than 50 per cent of the capacity installed at the end of 1948. The ability to produce electricity and the facilities for making more electricity in such relative abundance does not stimulate heroic efforts to develop radical new means of production.

Moreover, the efficiency of conversion in our most efficient steam plants has risen from 13 to 15 per cent only a few years ago to 38 per cent thermal efficiency—9,000 Btu. per kw-h.—in the best plants now being brought in.

One might almost say that one of the obstacles to rapid progress with nuclear power production is the rather bright prospect for conventional power production.

We keep overlooking the fact, too, that nuclear power is not a new kind of power but is only a *new fuel*. As such, it will be used in processes that have been under development ever since the steam engines of Newcomen and Watt. So even after all technical obstacles to perfecting a power reactor have been overcome, the most that we can hope for on costs is the cheapening of one of the elements in power production, namely, cost of fuel. But, while this happens we must also expect some—perhaps a large—increase in the capital cost of certain elements of the plant. And there does not seem to be any doubt that operation and maintenance of a nuclear reactor will be more expensive than that of a conventional plant—the thermal reactor.

An address given before the American Association for the Advancement of Science, at Cleveland on December 28.

Even so, the prospect of a radical reduction in the cost of the fuel component for power production and the hope that this can be accomplished without an increase in capital cost so great as to render nuclear reactors economically unsound is a sufficient reason to make industry vitally interested in the development of nuclear reactors.

Nor is there any inconsistency in this frank statement that while industry is—and should be—vitally interested in the development of nuclear reactors, there has been, up to now, an absence of sufficient challenge to industry in this field to produce a fully adequate response. The absence of challenge, moreover, has been coupled with a lack of opportunity—a point which I shall come to a little later. But for the moment I should like to examine the question of industry's interest in atomic power.

WHY IS ATOMIC POWER IMPORTANT TO INDUSTRY?

The problem of bringing about practical—and here I give special emphasis to the economic phase—atomic energy or power is admittedly difficult. Why, one might ask, should one persist? What makes it so important not to give up trying to bring about solutions to these difficult problems?

Development of nuclear power is important to industry not because of expected revolutionary consequences. It is important rather because it would provide a more universally available, more readily portable, and more economical fuel. For, if the more optimistic ideas as to breeding possibilities are realized, the fuel cost would be reduced to almost zero.

Chester F. Smith has recently presented the results of a study of the part of the energy market supplied by the four sources: hydro power, natural gas, coal, and oil, over the past decade, and the expected relationships

during the coming decade. This is shown in Table 1.

TABLE 1

SOURCES OF ENERGY USED IN THE U.S.

1,000 Trillion Btu.	Hydro Power	Natural Gas	Coal	Oil	Total
1940	0.9	2.8	12.7	7.8	24.2
1949	1.6	5.8	12.2	12.4	32.0
1960 (estimated)	2.3	9.8	13.6	17.2	42.9

With hydro power bound to decrease, as better sites become more and more used up, it is apparent that if *another highly economical fuel* gave promise of possibilities for development, natural pressures for such development would build up, if not before then, then surely when the reserves of present highly economical supplies, both in oil and gas, begin tapering off.

This will have an important bearing on those industries using fuel directly and on those—by far the larger percentage—using fuel as a source of electric energy. For it will not only protect and keep whole the entire base of economical fuel supply, but it might also lead to further expansion of electric use. For if cheaper power can be achieved through the use of atomic energy, several industries might well be stimulated. Examples are: reduction of magnesium and aluminum, refining of copper, production of cement, chlorine and caustic soda, electric furnace operations like the production of graphite, carborundum, calcium carbide, phosphoric acid, ferro-alloys, and electric steel. All these operations are characterized by a high figure of kilowatt hours per week per worker and a relatively low figure of wages per kilowatt hour used.

To put it another way, power costs in these industries represent a substantial percentage of total cost—as contrasted with a relatively minor percentage in most industries—so that an appreciable reduction in power costs, as by lower fuel cost, will materially reduce cost of product. The resultant application or use is bound to be stimulated.

The industries, then, that could benefit most from any appreciable reduction in the cost of electric energy are those just enumerated. The displacement of other forms of energy by atomic energy in these industries will be indirect. Atomic fuel will displace coal or gas or oil in new plants, or in rebuilt old plants, or white coal in hydro plants that might otherwise be built.

Some new electric processes might also be developed if atomic power is cheap enough: electric melting of general purpose glass, for example; or direct reduction of iron by electric processes; certain kiln operations might be electrified.

Whether or not atomic power will stimulate these existing processes or encourage the development of such new ones will depend on cost.

HOW CAN PRIVATE INDUSTRY BEST PARTICIPATE IN THE DEVELOPMENT OF ATOMIC ENERGY?

This question must be approached against the background just sketched: tough technical problems in the solution of which the traditional role of industry is more than ever necessary; no spur of pressing economic necessity to drive industry into atomic energy work because conventional power supply is at least good and its future prospects bright; but at the same time substantial incentive to get along with atomic power development because, if successful, it promises not inconsiderable advantages in abundance, cost, and convenience of fuel supply.

Now thus far, private industry has not had much part in atomic energy development. This has been only partly because economic advantages of successful nuclear power appear moderate rather than very high. There is already considerable history on the subject of why industry does not have a genuinely important role in atomic work. The report of the AEC Industrial Advisory Group[1] over two years ago gave an excellent analysis of this question and made a significant beginning in suggesting the means by which industry could be brought into atomic energy in an effective way.

The Industrial Advisory Group Report, while commending the AEC contract method of operation, demonstrated that this method represented only limited participation as compared with what was required if industry were to make a real contribution. As the report so succinctly states:

"The difficulty and the danger in the present situation is that industry's part in atomic energy is very limited as compared with the opportunities which exist and always have existed in other fields. The small number of companies which take significant part are selected by the government and the extent of their role in the work is limited by specific assignments from the government."

Probing for the cause, the Industrial Advisory Group further states:

"We think that today the central difficulty in getting a broad industrial attack on the problems of atomic energy is the fact that industry has no way of determining whether important opportunities in fact exist in which to take part."

And again:

"It has been stated that industrial opportunities in atomic energy are potentially unlimited. But they are at present so shadowy that businessmen neither know where to look nor what to look for. Today no one can say whether the prospect of profits or other incentives exist, because under present conditions the great majority in industry know little or nothing about the subject.

"The need for government monopoly in certain important areas, coupled with secrecy, seems to erect an impenetrable barrier to a wish for knowledge. If industry is to help in atomic energy and benefit from it, industrialists must first be put in a position to find out enough about the subject to determine whether and where there are in fact opportunities to take part. In devising means to this end, only the government can take the initiative. The government, which must exercise a broad monopoly and determine security regulations, alone is in a position to open the doors. Industry can, and we are confident that it will, cooperate. But government must first provide the catalytic forces that will set more of the normal processes of industry to work."

Even though more than two years have elapsed since the submission of this report, the basic difficulty so clearly pointed out by the Industrial Advisory Group has not been much alleviated. Industry still needs the things the Industrial Advisory Group advocated: more information about atomic energy; more opportunity for direct personal contacts between individual industrialists—technicians and executives—and the atomic energy program; greater utilization by government of the Industrial Advisory Committee concept.

The necessity for these things is clearly apparent today in any critical examination of the causes of the failure of private industry to participate or become involved to a greater extent than it has in atomic energy.

[1] Published in the *Bulletin*, V (February, 1949), 51–55.

We are still suffering from atomic illiteracy. There is a deadly parallel between the present situation with regard to atomic energy and the situation that existed shortly after World War I in the field of electronics. The electronic art made great strides, mostly through the development of military applications in World War I, but when the war was over what we had so far as the civilian population was concerned, or at least that part of it that didn't participate in the military program, was a state of almost complete electronic illiteracy. The consequence of that was that the predicted progress made during the early twenties did not fully materialize. It took almost a generation for that condition to cure itself, and it wasn't until World War II, more than a quarter of a century later, that the full fruition of what was started electronically in World War I took place.

The situation with regard to atomic energy in the post World War II period is much worse. Except for the relatively few people who are now engaged in the various laboratories and those among the various manufacturing organizations who participated and are participating in the atomic energy program, an almost complete state of illiteracy exists in the atomic field today in the United States. A few of our college professors and graduate physics students have some knowledge of the subject; the people of the National Laboratories possess it; and a limited number of people among the major manufacturers also. But, considering the size of the technical population of the United States, not to mention what it is if you consider the size of the business population, this group is woefully small.

Generally speaking, there is still no intimate contact between the Atomic Energy Commission and industry, apart from the AEC contract operators. The best evidence of the general soundness of the Industrial Advisory Group view that once opportunities appear, industry will take advantage of them, are the industrial proposals now pending before the Atomic Energy Commission for privately financed work on experimental reactors. But while these proposals are hopeful, much more ambitious private reactor work is desirable.

This brings in a difficulty of truly formidable proportions, and one which I have termed as Magnitude of Stakes. Because of the large amounts of capital involved in starting any program of research—let alone a program of experimentation on a full scale in the atomic power field—things that are possible in other fields of economic endeavor, such as in the chemical field, in the field of synthetic fibers, etc., are not possible in atomic power. In such other fields a large progressive industrial organization willing and able to stake a relatively few million dollars on research and development over a period of four to five years can bring itself to a position where, the research having proved successful, it can start and justify a full commercial scale operation by a capital investment, say, of the order of ten to twenty-five million dollars. Relatively large individual organizations in these fields can, therefore, undertake such programs on their own.

In the field of atomic power, the required investment is so much higher, and the nature of the application is such, that even large organizations find it impossible to undertake on their own any comparable programs. This is particularly so since the elements for evaluating the economic gain are still missing.

These, then, are some of the major obstacles to the participation of private industry in the development of atomic energy. It isn't possible, within the time and scope of this paper, to go into the possible means or the mechanisms for removing these obstacles. I am, however, hopeful that such ways and means will be found and, when that is done, the path will be cleared for more effective participation of private industry—for the release of those creative forces that have brought us along so far on the path of scientific, technological, and economic progress.

Gavin: Tactical Use of the Atomic Bomb

(*Continued from page 47*)

the holding of some three thousand square miles of real estate in South Korea. The weapons systems of the land forces, judging by the casualty reports, have been the hardest hit. Their fighting has been heaviest and their available weapons most taxed. A greater participation by the air-weapons system would add greatly to the successful outcome of the fighting. The most powerful tactical air weapon is the atomic bomb. Its delivery by our air forces would contribute greatly to the common battle achievement.

Setting aside the very serious moral and political considerations and considering only the tactical effects, large concentrations of division or larger size should not be allowed to go unscathed by atomic attack. Certainly several bombs on massed enemy forces wherever they can be attacked without endangering our own, would contribute greatly to their final, if not immediate, neutralization. It is hard to think of anything that would add more to the effectiveness of the U.N. forces. Here was an enemy forced to mass his means for a crossing both because of our defense and his own lack of mobility. He follows the traditional Soviet tactics of massing the men and means to do a job regardless of losses.

The bomb is the tactical answer to this problem whenever it is possible to deliver it profitably.

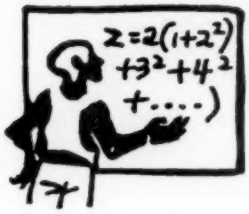
The military man recognizes the deep-seated political and moral convictions and ideals of our nation and its leaders, when the possible use of atomic weapons arises. He has no wish to override these vitally important considerations. But no one, military or civilian, who is conversant with modern weapons, including the atomic, can avoid comparing the tactical capabilities and limitations of those weapons. Nor can he help but see that in many tactical situations, the use of atomic bombs may greatly reduce the ultimate total of United Nations casualties.

Most certainly the possibilities of retaliation by the enemy will also be weighed by all who must give serious thought to the tactical uses of atomic weapons. These possibilities, however, can only be determined by the highest national authorities on the basis of estimated comparative availability of atomic weapons. Certainly, if the struggle for freedom continues, they will one day be faced by such a decision. And the military man would be completely lacking in judgment and common sense if he did not consider the tactical possibilities of atomic weapons in every combat situation that arises.

SUMMARY

In summary, the A-bomb is an excellent tactical weapon. It is much higher on the curve of deadliness than either the conventional bomb or the artillery shell. The greater the explosive effect of the atomic bomb the more effective it will be as a tactical weapon. And finally, if an H-bomb is developed and A-bombs become available for tactical employment, we should realize *now* that this will radically revolutionize land warfare.

FOUR YEARS UNDER LAW



W. W. WAYMACK

How well has the U.S. Atomic Energy Act worked in practice? This is the question which the Bulletin put to Mr. William W. Waymack, former editor of the "Des Moines Register and Tribune" and one of the original members of the five-man U.S. Atomic Energy Commission. Mr. Waymack served as commissioner from 1946 until his resignation in December 1948. Scientists who worked for the passage of the Act will be particularly interested in Mr. Waymack's evaluation of it.

THE best laws must be made to work by men. Men have to do this, not in a vacuum, but in the midst of conditions peculiar to the task and the times.

Any intelligent appraisal of the McMahon Act after four years must try to distinguish between possible defects inherent in the law and the imperfect functioning of men operating in a set of conditions peculiar indeed.

All that can feasibly be done now is to take a look at the "unclassified" record, to ask certain questions, and to seek balanced answers.

These seem to me to be the important questions:

1. What were the objectives of the McMahon Act?
2. How has the law worked up to now in relation to these objectives?
3. What were the real problems in trying to make it work?
4. To what extent has the nature of the real problems changed?

OBJECTIVES OF THE ATOMIC ENERGY ACT

The general objectives, in the determining of which atomic scientists and reinforcing groups were influential, were:

1. To strengthen national security in all the ways, short-run and long-run, made possible and necessary by the new knowledge;
2. To assure civilian control of the many-sided program required;
3. To discover and exploit the economic and other peaceful values;
4. To provide for fitting this novel governmental undertaking, despite secrecy requirements, into the pattern of "the American way," subject somehow to democratic control, avoiding serious or permanent injury to our basic values; and
5. To hold the door open for a contribution to world peace.

The passage of that law I consider a magnificent legislative achievement. Seldom, save during war, has there been such submerging of narrow and shallow considerations to the broad and deep. I recall no comparable instance of such abnegation of political partisanship. The mood was doubtless too exalted to be maintained indefinitely; but to be capable of it for a moment was very good.

How has the law worked?

Disregarding some cloudiness here and there in the law, evaluation of the law's working must look to what has been accomplished toward the large purposes. It must look to what has been resisted successfully as well as to what has been built. It must look to the realities of the environment in the first four years. It must look to the uncertainties and unanswered questions that are apparent now.

STRENGTHENING NATIONAL SECURITY

As to the paramount objective of strengthening national security, accomplishments have been very substantial indeed. Perhaps these would have come about under a different kind of law, but the fact is that they were accomplished under this law.

As has been officially announced, a bad situation as to dependable supplies of raw materials has been changed into a good situation. This sounds simple, but it wasn't. Production of fissionable material and of stockpiled atomic weapons has been satisfactorily increased. (We now have a weapon stockpile. And increased fissionable material, usable either in weapons or reactors, is of the very first importance.) Important improvements of atomic weapons and in methods of weapon production have been effected. As the President's published order to the Atomic Energy Commission last February made plain, research pointed toward a fusion-type weapon had been going on, and a stage warranting a large-scale development program was considered to have been reached. The reactors built for this project are wisely to be so designed as to be usable alternatively as plutonium factories.

These are just obvious highlights. The progress in this field involved scores of underlying things, ranging from new facilities to organization and morale, including new and important participants.

Moreover, everything ought to be measured against the state of affairs within the project toward the end of 1946, when operation under law began. At that time, one or two industrial operations were ticking along satisfactorily, but the project as a whole was in an appalling sag. The real "secret" then was how very weak we were, especially as to specific things in which it was assumed that we were strong.

Proper and necessary cooperation between the civilian commission and the Military Establishment has been repeatedly testified to. And, in fact, this, which took doing, has been excellent. Since this coordination was one of the uncertainties as to the working of the law, pessimistically emphasized by many, it is an important fact.

Despite all the periodic hubbubs, and the obvious hopes of many that

it would be otherwise, it appears that the record as to "Security of Information" since the law went into effect has been good. Every proof of a serious leak that has yet come to light runs back to the pre-law period.

The objective of strengthening national security for the short term has been well served.

THE DISSEMINATION OF INFORMATION

A great merit of the law was that it recognized the importance of long-range, as well as short-range, considerations. It recognized that for purposes both of peace and of national security it was essential to support basic research, to assure the training of more researchers, to disseminate technical and general information.

It was the pall of general ignorance and the strains of the international situation which led to the grasping for oversimplified and fallacious solutions that, for a good while, seemed to paralyze real progress in this area—the area of dissemination as a requisite for long-range strength. It was not the fault of the law.

It is really not surprising that we had in important quarters, including Congress, identification of security exclusively with secrecy, a tendency to look upon everything related to nuclear science as "classified," a low explosion point for any kind of dissemination whatever, hostility to spending money for long-range purposes including research, and all the concomitants of these reactions.

To introduce into this vital phase an adequate sense of balance was very difficult. The commission and the General Advisory Committee have been fully conscious of this need from the start. There was awareness of it and concern about it in most members of the Military Liaison Committee. Some members of the Joint Congressional Committee doubtless perceived it. But getting the wider understanding necessary for much progress required a slow educational process. It was dangerously slow; at times it seemed almost hopeless; and in some cases it required the shock of external events to break the mental log jam. For instance, it took the Korean crisis to overcome lingering resistance to the issuance of the Weapons Effects Handbook.

If Congress had chosen to give the civilian commission complete power, without any check upon it, in this field, it would have been theoretically possible to move much faster. Congress did not so choose, and I think this was wise. The law sets up, explicitly and implicitly, several important checks. The Joint Committee's function of asking quick amendment of the law is one. The provisions of the law concerning military applications is another—and the way this works needs better understanding.

The Military Liaison Committee must have access to all information related to military applications. Originally representing the army and the navy, M.L.C. naturally, when the air force became a separate service, represented all three services. It had the right of protest to any of the service secretaries against any commission policy affecting military concerns which it considered unwise. And each of the service secretaries had the right of carrying the protest to the President for final decision.

It is obvious that the Military Establishment does have vital responsibilities, and that *some* method of enabling it to discharge these in the atomic energy field was essential. It is obvious also that security of information was a proper area of military concern.

The fact that in this period we created a single Department of Defense and started the slow process of making "unification" substantial was a complicating but inescapable factor. The situation imposed delays. It was a situation in which a veto could be imposed by any one of the three services or by a single highly placed man in any of them who happened to have misgivings.

The alternatives were either to work these difficulties out patiently, or to dump in the President's lap scores or hundreds of conflicts, not over matters of general policy, but over specific and highly technical points. The latter was no practical alternative. The President should have fired any commission which proceeded like that. It would have compelled him to set up his own staff of experts, and such a staff would have had the same tough considerations to wrestle with. It is unlikely that such a set-up would have saved any time.

The nation's interest would have been better served if the desirable "moving balance" between secrecy and dissemination had moved faster. Yet, I can see today no more workable way than the way that was devised. The reasons for the sluggishness lie deeper than imperfect mechanisms. The tendency of secrecy to become an obsession, to feed upon itself and to creep, simply cannot be combatted without enough education to make both the people's representatives and a large part of the people themselves understand not only the price of inadequate secrecy but also the price of excessive secrecy. This is not easy, but for it there is no substitute.

There are rather numerous indications of late that the blockade has been broken, and that sensible answers in terms of policy have begun to supersede frustration.

Among the signs, in addition to the "Weapons Effects" book,[1] are the Atomic Energy Source Book,[2] finished and cleared at last; the announced decision to declassify information on low-power reactors, and the series of published reports of the commission to Congress. It is significant that the last of these semiannual reports was one of the most informative, yet that this one produced no thunder and lightning when it appeared last summer.

In this and in other long-range aspects of strengthening the national security, some real obstacles have been overcome and real progress has been made. For instance, a virtual order by a House Appropriations Committee that there be no informational service by the AEC did not stick. Another order that basic research be starved and all funds channeled into direct military applications did not stick. Without any centralized direction, and better so, our educational institutions shortly found ways of spreading general knowledge, and this, once started, has moved very well. And, if the barriers to public understanding of some very touchy things have been breached only a little by the orderly process of declassification, they have been substantially breached by another method that is perhaps an authentic part of the American way—by leak and blurt.

This is a method which is not open to the civilian commission. Facing realities, it is necessary to recognize that if the civilian commission or any of its people had made various revelations that, made in other quarters, provoked no storm, the consequences would have been serious. It is not merely that the roof would have blown off the Capitol building. It is that, among other things, the principle of civilian

[1] *The Effects of Atomic Weapons* (Washington: Government Printing Office, 1950).

[2] Samuel Glasstone, *Sourcebook on Atomic Energy* (New York: D. Van Nostrand Co., 1950).

control would have been gravely jeopardized.

However "irregular" some of the progress has been, the four-year record is such as to suggest that, while the difficult problem of balance between "secrecy" and "achievement" remains, it is not insoluble.

In any case, a law which foresaw this central need of balance is not to be discredited because the education of men had not proceeded far enough to enable them to understand it.

ASSURING CIVILIAN CONTROL

The second of the main objectives of the law, as I chanced to list them, was assuring civilian control.

The principle and national policy of civilian control have been successfully maintained. In order to maintain the principle it was imperative to perform successfully the military part of the job. The forces opposed to civilian control understood perfectly that their chance of destroying the principle lay in hampering and discrediting the commission. These forces, it needs to be said, never included the Military Establishment nor its principal chiefs, though of course they did include a few military individuals. More formidable than these few, though obviously in tacit or covert alliance with them, were a certain segment of the press and certain forces behind it—a relatively small segment, but vociferous, persistent, uninterested in accuracy, and poison-fanged.

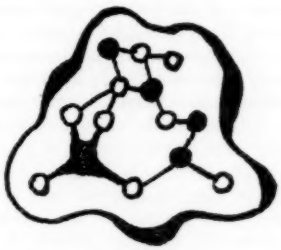
The numerous five-alarm sensations about supposed security leaks, all of which flattened out, were, in large measure, part of a campaign of discrediting. While they failed in this aim, they did keep an uninformed Congress jumpy; they were harassing in themselves and they led to other very handicapping harassments.

The issue of civilian control was involved also in the one full-dress appeal to the President for decision of a conflict between the commission and the Military Establishment over custody of atomic weapons. The conscientiousness and good faith of the chiefs of the Military Establishment in this controversy could not be questioned. It was not, on their part, a move to "take over." That some maneuverers saw in the superficially simple custody issue only a "first bite," which, if taken, might be succeeded by additional bites, is, I think, equally unquestionable. In the issue as it finally shaped up there were technical considerations not visible to the public eye, and there were also deep considerations of public policy. The President's decision is well known. It did make the civilian control principle more secure.

The device of the Military Liaison Committee, thanks to some excellent men, did not become, as some had feared, a continuous challenge to civilian control.

In short, both the law's provision for appeal to the President and its provision for M.L.C. were made to work in terms of the law's real purposes.

New threats and challenges to civilian control may come. But to have survived the first four years with the principle still on top is excellent. The public is better equipped to be the watchdog on this in the future.



FURTHERING PEACEFUL USES OF ATOMIC ENERGY

There has been constant speculation about "peaceful uses" of atomic energy, and a common assumption since 1947 that progress toward peaceful uses has been greatly delayed by necessary concentration on defense. The assumption, I think, is still mistaken, though time may change this.

Applications of the new knowledge in biology and medicine, and in agriculture have not been at all delayed. Applications of tracer techniques in industry have probably been made as fast as they would in any case. "Cleared" technical people of many industrial companies have access to other information.

Even as to power production, I do not think we should have been further along without the need of and the money for development of a navy power plant, regardless of its economy. Even with no secrecy barriers at all, it is most unlikely that private enterprise would have felt justified by now in spending hundreds of millions of dollars to design, build, and operate experimental nuclear reactors aiming at eventual economic power production. Nor is it likely that the government would by now have embarked on the huge Arco project, at the cost and pace involved, but for the military urgency.

FITTING THE ENTERPRISE INTO THE AMERICAN PATTERN

Implicit throughout the Atomic Energy Act was the major purpose of fitting the strange, new enterprise into "the American way." Clearly much has yet to be accomplished before this can be considered done. Intelligent consideration of "where we stand" after four years requires examination of at least a sample or two of the acute problems, an examination of the activities of the principal agencies set up by the law, and a glance at the peculiar management problems faced by the commission.

The law created not one agency but four—the Atomic Energy Commission, the Joint Congressional Committee, the Military Liaison Committee, and the General Advisory Committee on scientific and technical matters.

The real test does not concern the obviously inevitable headaches of cooperation and coordination. It is the way in which each agency faced up to its basic responsibility for achieving the law's goals.

I think the commission (which had the advantage as well as the burden of exclusive concentration on this) at least did not make the mistake of being unwilling to see the job whole. The General Advisory Committee certainly did not duck its responsibility. The Military Liaison Committee deserves a good mark also.

RELATIONS WITH THE JOINT COMMITTEE

Wherever the blame lies, the place where "making the law work" came closest to failure in the first years was in relations between the commission and the Joint Congressional Committee. Since only the effects in this field, and only a few of these, have become publicly visible, an examination of the causes has been hardly possible. But it is important.

The Joint Committee, of course, consisted of elected politicians. I use the term not as an epithet but as a reality, and one which no person who believes in the American system can deplore. The committee included some very able men. Its most influential members, clearly impressed by the special importance of the task, did very well in taking a nonpartisan approach in the beginning. A real effort was made to stay "nonpolitical" continuously, though this was naturally not within the powers of all. In some of the more obvious and easily understood ways, a good record was made in putting the political Satan behind.

For instance, little or no attempt was made by any committee member to treat jobs in the commission's staff as part of the spoils system.

The Joint Committee early faced one relevant problem as to its correct role, and properly decided that it must not try to act as a super-administrative body.

And on several occasions the committee was helpful in getting stricken from appropriations measures (or in neutralizing) foolish riders that would have crippled some important operation.

With due credit for such instances of adequate functioning, the fact remains that relations between the commission and the committee deteriorated badly. In looking at the reasons, it is necessary to recognize political realities and the handicaps that afflicted the Joint Committee.

In an over-all sense, the Joint Committee functioned in the first years too narrowly. I am inclined to think it was inevitable. In the first place, while a few of its members were better informed than most, the Joint Committee shared the general unpreparedness to look with understanding at the whole complex of problems. And it proved impossible to get a large enough share of the time (and serious study) of committee members to correct this rapidly. Some of the ablest members were necessarily so preoccupied with other responsibilities that they could not possibly concentrate on this one.

In any case, the commission's efforts to set up joint meetings, fully attended, for the purpose of informing the committee adequately as to all phases of the atomic energy program, failed. Though the effort was continuous, results petered out. Joint meetings, public hearings, and private hearings became infrequent and limited to specific subjects, usually controversies and fears of the moment.

The greater part of communication became "paper work." It centered increasingly on security matters. It tended to take the form of time-consuming replies to letters apparently designed to make a written record.

One important factor behind this was the fact that the Joint Committee's staff for a long while consisted of just two key men—both doubtless competent men in their field, but both security officers, with no claim to special competence outside their one field.

Behind this deficiency as to staff, but probably influenced by it, was the limited effective interest of the committee in its own scope of functioning. It was marked by the obsession with security, narrowly defined. Essentially what this meant was a tremendous and constant emphasis on "Security through Secrecy" with no commensurate emphasis on "Security through Achievement." The congressional committee on which Congress had to depend for a sense of balance in the whole field did not quickly become able to interpret balance wisely.

Behind these facts were still other realities, broad and pervasive. A major one was politics—politics of the kind that could not be escaped.

I shall mention but two phases of this.

One was the natural sensitiveness of senators and congressmen to any sensational possibilities, politically explosive. This generated a rather prevalent defensive reaction. It narrowed intense interest to labor disputes (the growing pains of fitting normal American methods to the strange industry), to domestic uranium prices, and, above all, to preserving the Maginot Line of Secrecy. The environment was one of secrecy scares, some of them probably "engineered." And important in this environment was the Parnell Thomas committee, then going very strong, which made various members of the Joint Committee very jumpy indeed. Part of the almost complete disinterest of most Joint Committee members in any security leak, however injurious, that proved, after a great alarm, to have occurred before the commission took over, may have been because Joint Committee members could not be accused of failing to be good enough watchdogs in such a case.

The one other political consideration that must be remembered is the fact that simultaneously with appointment of the commission and application of the law there was a national election which created one of our always difficult periods of a divided government. The opposition took control of Congress. The opposition was confident that it merely had to wait two years before taking over the executive also. This threw both commission and committee into the middle of a situation that started tensely and got more tense. As usual in such circumstances, the struggle over constitutional prerogative developed between White House and "The Hill." Since part of this was over loyalty files, it embittered things affecting commission and committee. The effects were bad, even though no actual dispute on this point developed between commission and committee.

Moreover, membership on the commission, looking ahead beyond '48, immediately became an issue. The fact that under the law the terms of all commissioners expired simultaneously in the summer of '48, appointments thereafter to be for staggered terms, guaranteed that this would have maximum political interest. The eventual decision to extend all terms for two years, leaving the staggered appointments to the next President, was the upshot. From the standpoint of getting the complex atomic energy job done, unimpeded by politics, the circumstance was bedeviling. It was probably no easier for the Joint Committee than for the Atomic Energy Commission.

The result was that, instead of growing mutual helpfulness, there tended to be increasing misunderstanding and harassment.

Worth noting as one indication of the Joint Committee's focus, as it actually functioned, was its refusal to accept certain information as to atomic weapons. Fear of a leak that would hurt the national interest (this much more than fear of embarrassment to the Joint Committee) was doubtless the reason. That is understandable. What it illustrates, however, is a concern about secrecy so great that it overrode concern as to the Joint Committee's obligation to keep "fully informed" so that it could accurately advise the Congress whether the job was going well.

In retrospect, I consider that concentration of the Joint Committee's real interest in narrow fields was regrettable, but that the circumstances, not all of which I have listed, probably made it inevitable. And it is my opinion that this part of the situation has become substantially better.

I early suggested that serious mistakes successfully resisted are a not unimportant part of the record. Only those who went through it can know how great were the pressures toward some mistakes. Two illustrations will suffice.

The pressure to produce some "easy answer" to the problem of labor relations at industrial installations is one. That one I shall merely mention without amplifying. Not an "easy answer," but a workable and American answer, has evolved. The second illustration is in the field of personnel clearance. Again, it was the grasping for a simple answer that built up tremendous pressure. There was a plausible argument behind this, and it was very attractive to some unquestionably con-

scientious and patriotic men. The syllogism ran like this:

1. Protection of secrets that are clearly vital to our national security is a consideration which must override all others.
2. Our atomic energy secrets are in that category.
3. Therefore, the consideration of justice to individuals must, however greatly we regret it, be disregarded.

It is my personal guess that if the commission had been willing to surrender its conviction that this was the wrong way, both from the standpoint of basic American values and from the standpoint of achieving maximum security, its path would have been substantially smoothed as to other things. It is my belief that by sticking to its hard look at implications, by trying to assess probable consequences, including those to the military program, and by declining to forego constant effort to set up orderly and balanced procedures with an authentic ingredient of individual justice, the commission performed a duty rather important to our major objectives.

Educating Congress, like educating any of the rest of us, into sufficient understanding of a new and bewildering field of interest to permit policies based on balance, is bound to be difficult and slow. The necessary educating is hardly to be done by an orderly process of attending classes and taking weekly examinations. The necessary education comes piecemeal, largely by osmosis, and it follows a logic of its own. It starts with something exciting that seems simple and readily understood, such as a horrendous scare about "lax security" or an expenditure for schooling in Los Alamos that looks exorbitant compared with expenditures in an old New England town of comparable size. With tumult and headlines the particular "atrocity" is pursued to the end—and the real end is a significant amount of education. Painful as it always is, this unmethodical method has worked. There was no other that would.

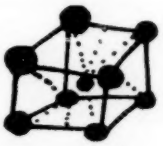
THE PROBLEM OF MANAGEMENT

As to the scheme and system of management under commission and general manager, I shall do little beyond identifying this as a field in which sound answers are essential. Sound answers must be workable ones, not for the moment alone but for at least the "middle-term." There have to be principles behind them, compatible with major objectives. But in application they cannot be all theory, rigidly doctrinaire. There is bound to be much of cut-and-try; pragmatically the right answer is the one that works.

The task here was to invent a management scheme with a workable balance between centralization and decentralization, between "staff" and "line" functioning, and between other alternatives. Establishing and maintaining a line, inevitably fuzzy but nevertheless real, between commission (a board of directors in continuous session) and the general manager (the president in charge of operations) was and is both necessary and difficult.

And the recruiting of able men, essential to make any management scheme accomplish anything, was altogether vital, yet, because of adverse factors, extremely difficult.

In general, I believe that in staff and plan the commission today has a good foundation.



One problem of management worth pulling out for a look is that of providing main channels and cross-channels of communication throughout the organization, so that brains shall not be wasted, so that the frustrations of many men and groups at the ends of long lines shall not mount. For various reasons, including preoccupation of commission and staff with harassments, progress in solution of this problem has been not so rapid as it should have been.

It is not evident that any major structural change would substantially lessen difficulties or substantially increase the likelihood of achieving our objectives faster. I am convinced that, at least for the early period, the main decisions as to structure were wise. The Joint Congressional Committee was an obvious "must." The full-time commission and five-man membership I consider to have been correct. The General Advisory Committee was a legislative godsend. The compromise provision for a Military Liaison Committee has justified itself in two ways. It avoided the probable alternative, which was a commission part-civilian and part-military, in which the numerical civilian majority could easily have proved to be what some intended it to be: a "public relations" facade for the reality of military control. And, on the affirmative side, the device worked well. With the advantage of hindsight, I do not think anybody today could suggest a better device for making relations between AEC and the complex Military Establishment manageable.

There has been some criticism of certain recent developments, all having to do with the realities of administration. There has been renewed fear of "political appointments." There have been assertions that the Joint Committee was forgetting its sound rule of not trying to administer, and might be drifting into the role of exercising administrative authority without assuming corresponding responsibility. And there has been a charge that the conditions for good management may be upset by projecting the commission itself from its proper policy-making role into a role of detailed interference in nonpolicy decisions of management. A recent amendment to the law, making the general manager an appointee of the commission instead of the President, though still subject to Senate confirmation, fits into the same concern.

I think it is too early to say how these things will work out. It is proper to have it pointed out that there are dangers. The need of sensitivity toward the proper roles of legislative and executive, and toward the proper roles of the commission and of the general manager and his staff, will be continuous. I assume that it will be continuously present.

On the national objective of making our handling of atomic energy problems contribute to peace I omit comment, none being needed.

CONCLUSIONS

I have deliberately avoided reference to individuals and concentrated on developments. Distribution of deserved praise would have been impossible. As a major factor in everything, however, the devoted work of people, including scientific teams, must be emphasized. The fact that this could be obtained, in circumstances most trying, says something as to democracy's still unexhausted natural resources.

While hardly a "new agency," the President, under the Constitution and under the Act, has a crucial role in all the atomic energy problems. Evaluation of the first four years would be incomplete without a recognition of

this. If sensitiveness to major values, decisiveness on major issues, and a basic nonpolitical approach are important, as I consider them to be, we have had them.

One of the aims of the law in which no great accomplishment can be claimed is that of encouraging competition in private industry. Probably as much has been done as could be done. Fruits may be greater as time passes. Indeed, the substantially broadened base of industrial participation indicates this. But if the expectation was that small industry could be strengthened relative to big industry, I fear that was largely illusion. The reasons lie in factors that are pretty inexorable. Certainly in the early and urgent stages only giants have been capable of undertaking the really big tasks.

Forced to reflect and distill by the *Bulletin*'s request for a considered "evaluation," I find myself convinced of two things. First, after four years of trial, the law requires no changing as to fundamentals. Second, despite the follies and inadequacies of men, largely stemming from want of familiarity and understanding, the difference between the situation four years ago and the situation now is very encouraging as to our capacity to work our way through handicaps successfully.

While, as I have said, the law has been made to work well in achieving its major objectives, there are clearly places where amendment for clarification and even some modification of probable intent would be helpful. Inevitably, a few apparent contradictions or at least ambiguities came into focus through experience. Indeed, they came into focus early. Two considerations, I believe, have heretofore dictated restraint by the commission in asking for amendment. One has been the obvious desirability of seeing whether conscientious and sensible interpretation would not prove sufficient. Another has been the grave danger that if the issue of revision were opened to relieve a few headaches, the result would be a decision by the doctors to disembowel.

The high mood of 1946, which was based on awe rather than understanding, had gone. Partisanship, prejudice, and fear were bound to be important in any congressional overhauling. Real education in the problems, the only possible corrective, had progressed only a little. There was not merely a possibility, but rather a strong probability, that the result of an attempt at revision would have been a concentration on just one thing —the supposed strengthening of security by greatly increased reliance on the simple, tempting, though illusory, answer of "Secrecy to the *n*th power" regardless of its cost.

Prior to Russian achievement of an atomic explosion and to revelation of wholesale leaks of really critical weapons information long before the law was passed and the civilian commission created, revision would almost certainly have consisted of putting much heavier brakes on progress and could easily have involved restoring wide military control, in reality if not in form.

The situation now is better. With adequate experience behind us, the points at which clarification or adjustment to external realities is needed should be clear. As one illustration, the ban on any exchange with Britain of information that might be useful in industrial development hardly has any meaning now except as a barrier to the exchange of mutually helpful information which the times make sensible.

The commission has stated publicly that it intends to ask of Congress certain amendments shortly, and has indicated the nature of some of them. These are aimed at greater freedom (and more practical realism) in the handling of restricted data. An illustration given is information about the size and contour of "the gadget," which has to be known by thousands when air crews are trained with it. There are numerous other spots at which a freer hand would help security. In so far as the commission's amendment proposals have been explained, they appear wholly sound. The fact that rational consideration of them is now considered likely—a conclusion supported by unhostile murmurs in some legislative quarters—is an excellent sign. And, while re-debate will doubtless produce considerable heat and nonsense, it seems probable that education-by-jolt has progressed sufficiently to assure a balanced result —specific, purposeful amendments, not evisceration.

Whatever is still inadequate, uncertain, or risky in our national atomic energy experiment is not to be attributed in any important degree to the law in its fundamentals. It is not to be attributed primarily even to the pettiness of man; for pettiness and malice we deal with constantly in our whole larger experiment of self-government.

Most congressmen, like most other laymen, have been as genuinely baffled by atomic energy problems as laymen were (and still are) when confronted with the fourth dimension.

Congressmen are equipped by personal and official experience to deal with things familiar to our past. For illustration, they have no difficulty understanding that in order to enable the business man to perform his useful function it is necessary that conditions be reasonably propitious—taxes, incentives, and the rest. To comprehend that for the scientist to perform his now indispensable function conditions must be reasonably propitious is, on the contrary, very difficult. This is but one of the many kinds of difficulties—a mere random sample, yet typical in its nature. The adjustment takes time.

Chemist Conant a few years ago sampled the problem, added a few reagents, and precipitated the pure salt of one ingredient—the need of "assimilating an understanding of science into our culture." If "culture" suggests a process five generations long, another word is needed. Progress is being made. Considerably more of it is necessary before we can reasonably expect every person strategically placed to see the problems whole and to react accordingly. We should deceive ourselves if we let impatience persuade us that short cuts abound.

LOCAL GOVERNMENT LOOKS AT THE CIVIL DEFENSE ACT

FRANK P. ZEIDLER

On January 12, President Truman signed a bill creating a federal Civil Defense Administration and initiating a program estimated to cost over three billion dollars. In this issue we publish the text of the Act in abridged form and the first of several articles commenting on it. Mr. Zeidler, mayor of Milwaukee, Wisconsin, heads a vigorous municipal civil defense program.

THE passage and signing of the civil defense bill has been watched with great eagerness by all state and local defense agencies in the nation.

From the point of view of a head of local government, I detect a spur to this eagerness which is something less than noble. The sum of $1,125 million is proposed for shelters, $100 million for heavy equipment, $400 million for critical material stockpiles, and $32 million for communications. City officers are spurred by public pressure to get as much of this money as they can —even though they do not quite know how they will spend it.

I will not comment on the legal aspects of the bill. Granted its assumptions, it appears to be a workmanlike job; but these assumptions and their practical effects as spelled out in this bill merit close inspection.

PASSIVE DEFENSE— PREMISE OF THE BILL

One of the prime assumptions of the bill appears to be that target areas, especially cities, can hope only for passive defense. Administrators of cities, in most instances, do not know of any active defense for their cities since this active defense is presumed to be the responsibility of the military.

Can it be that the active defenses are so meager as to be ineffective at this stage and for a long time to come? Current literature on the subject seems to indicate that the military accepts the fact of large losses from initial sneak attack by an enemy and hopes to counter only by striking back harder. A recent article on the Strategic Air Command implies that a heavy first-struck blow by an enemy may leave us helpless.

The civil defense bill appears to accept this relative defenselessness of the cities both because the weapons of offense have surpassed the weapons of defense and because such weapons of defense as may exist are inadequate.

This is a fundamental premise of the bill whose consequences cannot be ignored. Psychologically, it serves to create a feeling of futility and helplessness. Mechanically, it has set in motion a tremendous program of public expenditure to produce physical changes in target areas.

The acceptance of the relative defenselessness of targets by the civil defense bill, however, must not be taken to be a flaw embodied in the bill by the agencies which drafted it. Rather it appears to be a hard fact which stems from the unwillingness of the people of the democracies to accept the logical consequences of atomic energy.

AUTHORITY GIVEN STATE GOVERNMENTS: POWERLESSNESS OF CITIES

A second important foundation of the bill is that the federal Civil Defense Administration proposes to deal only through the states and not directly with governmental subdivisions representing the target areas. In an earlier article[1] in these columns, I pointed out that it would be an error not to deal directly with these units of government, since the states with their rurally dominated governments have not been sensitive to the danger and, even now, are laggard in providing emergency authority and funds to meet the present emergency.

The civil defense policy statement of the American Municipal Association reiterates my earlier position. The statement says in part:

"There is one fundamental error in the policy and program recommended by the Office of Civil Defense of the National Security Resources Board. . . . First, the federal civil defense authorities have announced their determination to deal only with the states, leaving cities of all sizes and circumstances dependent on their state governments for the transmission of information from federal sources and for all contacts with the federal Civil Defense Administration. Second, the federal program and policy proceeds on the assumption that state officials will take over and direct the total civil defense effort within their states, including facilities and resources of the cities. The policy is carried so far that the legislation recommended to the Congress would literally make it impossible for the federal Civil Defense Administration to deal directly with any city, even a critical target city, regardless of the incompetence of the state civil defense organization. This is sheer folly."

The policy statement has more in the same vein, and justifiably so. The threat of hanging produces a wonderful concentration of the mind; the cities, threatened with destruction, are wonderfully concentrated on the prob-

[1] "A Mayor Looks at the Civil Defense Problem," *Bulletin*, VI (August–September, 1950), 240–51, 286.

lem of saving themselves. They have taken the initiative. The states—even the best of them with good administrators such as my own state—have not met the problem.

The states have not transmitted civil defense information *to* the cities; they have obtained it *from* the cities. The cities have obtained their information from the American Municipal Association and the United States Conference of Mayors. With a few exceptions, the liaison between state officials and local officials has not been active. In addition, the states are generally not prepared to advance sizable sums to man their own organizations. The emphasis they tend to give civil defense is on what they will do after a catastrophe has occurred rather than on what should be done now to reduce the vulnerability of the critical targets.

PROVISIONS FOR FINANCING: MATCHING STATE AND FEDERAL FUNDS

The power and authorities of the states have been increased by another fundamental action—namely, the provision that funds for civil defense will be allocated to the states who must provide matching funds. Acting under home pressure, the cities want a quick expenditure of funds. The state legislatures which must provide the matching funds will be loath to tax the smaller communities or rural areas for these funds. Matching funds, therefore, may be obtained principally from the cities by one device or another.

Some states, already financially embarrassed, have demanded that the federal government should provide considerably more of the funds than it plans to do now. On this point Governor Dewey has called the plan unworkable for his own state.

The limits of the use of the federal grant, then, will be determined, not by the generosity of the federal government, but by the ability of the state governments to force matching funds out of the cities.

Assuming as we do under the federal civil defense bill, that large sums of money must be spent for shelters, equipment, and for supplies after an attack, there are several problems which must be faced.

Will the states spend most of the money for "perimeter" defense instead of in the target area? This they can conceivably do under the bill as written.

PROBLEM OF SHELTERS

Supposing the states spend the funds in the target areas, what will they spend them for? If for shelters, what kind—subterranean, mass, or individual? Who will allocate materials—particularly cement, steel, and communications materials?

I will suggest some answers, in order to illustrate the point that sums of money of themselves are no answer to defense.

Every city will have a different defense answer, owing to its location, population density, soil conditions, topography, and other factors. For the larger cities, shelters should be provided in the core of existing buildings and subways to the maximum possible extent. Where feasible, it will pay to extend laterals off of subways according to European models.

Where subsoil conditions do not permit underground shelters, certain mass shelters, like those built in German cities, may be constructed. These shelters, however, if struck by a direct hit, would cause a great demoralization.

Home shelters, not in the basement, and simple street shelters of brick or concrete boxes, suitably protected from radiation by earth cover or sand bags will have to serve the majority of people. Basement shelters are now being encouraged, but these can be extremely deadly if adequate ceilings and exits are not furnished.

Dual purpose shelters, which the federal civil defense bill dwells on at some length, might well prove unworkable. How available would an underground car-park be if filled with cars during an emergency? Furthermore, it could not provide the proper compartmentation necessary for good defense.

It can readily be seen, therefore, that a liberal application of federal funds, contemplated in the federal bill, does not provide an automatic answer. As I told the people of Milwaukee: "Large sums of money may be appropriated and misspent for civil defense before basic theories have been worked out." Cities should begin working on sample structures at once to be sure that they will spend their funds properly.

LACK OF COORDINATION AMONG FEDERAL AGENCIES

The federal act also does not cover clearly the necessity of coordinating the various federal agencies dealing with cities and the Civil Defense Administration. Last year I urged Stuart Symington, NSRB head, to coordinate the work of such agencies as the Public Housing Administration, and the Bureau of Roads with civil defense. If some federal agency gives funds to a city for an expressway or a slum clearance project, this work should be coordinated with civil defense.

As a case in point, it may be that a housing authority which clears out a slum should leave it cleared, and build anew elsewhere with less population density. So far as I can ascertain, however, the needs of civil defense have not profoundly stirred any of the agencies to change their basic thinking established in peacetime.

Similarly, federal funds could conceivably be used to accomplish a dispersal of the target area, instead of fixing it by expending the same funds for permanent shelter construction. Over a period of time, this latter objective must be accomplished.

The federal Civil Defense Act comes into existence with the best of intentions under its basic assumptions of the relative defenselessness of cities, the superior powers of state government, the ability of the states to decide properly who will pay matching funds and how best they will be spent.

Up to now, this general pattern of state responsibility has not worked too well. It will be up to the federal advisory committee, authorized under the act, to see that target areas are adequately protected. The advisory committee will consist of six members representing the public at large, three representing the states, and three representing local government. These last three must make sure that the objectives of civil defense are not lost in the inevitable prior administrative interests of the federal and state governments.

If the objectives are lost, the act will be dangerous indeed.

FEDERAL CIVIL DEFENSE ACT

That this act may be cited as the "Federal Civil Defense Act of 1950."

DECLARATION OF POLICY

SEC. 2. It is the intent of Congress to provide a plan of civil defense for the protection of life and property in the United States from attack. This responsibility for civil defense shall be vested primarily in the several states and their political subdivisions. The federal government shall provide necessary coordination and guidance; shall be responsible for the operations of the federal Civil Defense Administration as set forth in this act; and shall provide necessary assistance as hereinafter authorized. . . .

TITLE I—ORGANIZATION

Federal Civil Defense Administration

SEC. 101. (*a*) There is hereby established in the executive branch of the government a federal Civil Defense Administration at the head of which shall be a federal Civil Defense Administrator appointed from civilian life by the President, with the consent of the Senate. The federal Civil Defense Administrator shall receive compensation at the rate of $17,500 per year.

(*b*) There shall be a Deputy Administrator appointed from civilian life by the President, with the consent of the Senate, and who shall receive compensation at the rate of $16,000 per year.

(*c*) The administrator shall perform his functions subject to the direction and control of the President.

Civil Defense Advisory Council

SEC. 102. (*a*) There is hereby created a Civil Defense Advisory Council, which shall advise the administrator on policy matters relating to civil defense. The council shall consist of the administrator as chairman, and twelve additional members to be appointed by the President, of whom three members shall be representative of the state governments, three members, representative of the political subdivisions of the states, and the remaining members selected among the citizens of the United States. The following organizations shall be invited to establish panels of names for the members representative of the states: the Council of State Governments; the Governor's Conference; the American Municipal Association; and the United States Conference of Mayors.

The representatives of the states appointed by the President shall be selected from the panels established by the abovementioned organizations. The council shall meet at least once a year and at such other times as the administrator shall determine.

(*b*) The administrator may appoint such other advisory committees as are deemed necessary.

(*c*) The members of the council and the members of any other advisory committees, other than the administrator, may be compensated at rates not in excess of those prescribed in section 401 (*b*) of this act.

TITLE II—POWERS AND DUTIES

Detailed Functions of Administration

SEC. 201. The administrator is authorized, in order to carry out the abovementioned purposes, to—

(*a*) Prepare national plans and programs for the civil defense of the United States, making such use of plans and programs previously initiated by the National Security Resources Board as is feasible; sponsor and direct such programs; and request such reports on state plans and operations for civil defense as may be necessary to keep the President, the Congress, and the several states advised of the status of civil defense in the United States;

(*b*) Delegate, with the approval of the President, to the several departments and agencies of the federal government appropriate civil defense responsibilities, and review and coordinate the civil defense activities of the departments with each other and with the activities of the states and neighboring countries;

(*c*) Make provisions for civil defense communications and for dissemination of warnings of enemy attacks;

(*d*) Develop civil defense measures designed to afford protection of life and property, including research as to the best methods of treating the effects of attacks; developing shelter designs and materials for protective covering or construction; and developing equipment or facilities;

(*e*) Conduct training programs for civil defense officials and other persons in the organization, operation, and techniques of civil defense; conduct schools including the furnishing of subsistence and quarters for trainees and instructors subject to reimbursement on terms prescribed by the administrator; and provide instructors and training aids as deemed necessary: *Provided*, That not more than one national civil defense college and three civil defense technical training schools shall be established under the authority of this subsection: *Provided further*, That no land shall be acquired and no buildings shall be constructed pursuant to this subsection unless specifically authorized by the Congress;

(*f*) Publicly disseminate civil defense information;

(*g*) Assist the states to negotiate interstate civil defense compacts; review the terms of such compacts to assist in obtaining uniformity therein and consistency with the national civil defense plans: *Provided*, That a copy of each such civil defense compact shall be transmitted promptly to the Senate and the House of Representatives. The consent of the Congress shall be granted to each such compact, upon the expiration of sixty days if there has not been passed a concurrent resolution stating that the Congress does not approve the compact: *Provided*, That nothing in this subsection shall be construed as preventing Congress from withdrawing at any time its consent to any such compact;

(*h*) Procure by condemnation or otherwise, construct, lease, transport, store, maintain, renovate, or distribute materials and facilities for civil defense, with the right to take immediate possession thereof: *Provided*, That facilities acquired by purchase, donation, or other means of transfer may be occupied, used, and improved for the purposes of the act, prior to the approval of the title of the Attorney General as required by section 355 of the Revised Statutes, as amended (40 U.S.C. 255): *Provided further*, That the administrator shall report not less often than quarterly to the Congress all property acquisitions: *Provided further*, That on and after January 1, 1952, the administrator shall not acquire any land, or any interest therein, unless specifically authorized by Congress.

(*i*) Make financial contributions, on projects approved by the administrator, to the states for civil defense purposes, including procurement, construction, leasing, or renovating of materials and facilities. Such contributions shall be made on such terms as the administrator shall prescribe, including the method of purchase, the quantity, quality, or specifications of the materials and such other factors to assure the uniformity, availability, and good condition of such materials or facilities: *Provided*, That, except as otherwise provided in section 303 (*d*) of this act, no contributions shall be made for state or local personnel and administrative expenses, or for items of personal equipment for state or local workers, or for the procurement of land: *Provided further*, That the amounts authorized to be contributed by the administrator to each state

for organizational equipment shall be equally matched by such state from any source it determines is consistent with its laws: *Provided further,* That financial contributions to the states for shelters and other protective facilities shall be determined by taking the amount of funds appropriated or available to the administrator for such facilities in each fiscal year and apportioning same among the states in the ratio which the urban population of the critical target areas (as determined by the administrator, after consultation with the Secretary of Defense) in each state, at the time of the determination, bears to the total urban population of the critical target areas of all of the states: *Provided further,* That the amounts authorized to be contributed by the administrator to each state for such shelters and protective facilities shall be equally matched by such state and, if not matched within a reasonable time, the administrator may reallocate same to other states on the formula outlined above: *Provided further,* That the value of any land contributed by any state shall be excluded from the computation of the state share: *Provided further,* That the amounts paid to any state under this subsection shall be expended solely in carrying out the purposes set forth herein and in accordance with state civil defense programs or projects approved by the administrator: *Provided further,* That the administrator shall make no contribution toward the cost of any program for the procurement, construction, or leasing of any facility which (1) is intended for use, in whole or in part, for any purpose other than civil defense and (2) is of such kind that upon completion it will, in his judgment, be capable of producing sufficient revenue to provide reasonable assurance of the retirement or repayment of such cost, except that (subject to the foregoing provisos of this subsection) he may make contribution to any state toward that portion of the cost of the construction, reconstruction, or enlargement of any facility which he shall determine to be directly attributable to the incorporation in such facility of any feature of construction or design not necessary for the principal intended purpose thereof but which is, in his judgment, necessary for the use of such facility for civil defense purposes. Whenever the administrator, after reasonable notice and opportunity for hearing the state, finds that there is a failure to expend funds in accordance with the terms and conditions governing the federal contribution, the administrator shall notify such state that further payments will not be made until he is satisfied that there will no longer be any such failure. Until he is so satisfied, the administrator shall either withhold the payment of any financial contributions to such state, or limit payments to the program with respect to which there is substantial compliance with the terms governing the federal contribution: *Provided,* that the administrator shall report not less often than quarterly to the Congress all contributions made pursuant to this subsection.

(*j*) Arrange for the sale or disposal of materials and facilities found by the administrator to be unnecessary or unsuitable for civil defense purposes in the same manner as provided for excess property in the federal Property and Administrative Services Act of 1949, as amended, and any funds received as proceeds from such materials and facilities shall be covered into the Treasury as miscellaneous receipts.

Mutual Aid Pacts between Several States and Neighboring Countries

SEC. 203. The administrator shall give all practicable assistance to states in arranging, through the Department of State, mutual civil defense aid between the states and neighboring countries.

Identity Insignia

SEC. 204. The administrator may prescribe insignia, arm bands, and other distinctive articles which may be manufactured for, or possessed, or worn by persons engaged in civil defense activities pursuant to regulations established by the administrator. The manufacture, possession, or wearing of any such insignia otherwise than in accordance with such regulations shall be unlawful and shall subject such person to a fine of not more than $1,000 or imprisonment of not more than one year, or both.

TITLE III—EMERGENCY AUTHORITY

National Emergency for Civil Defense Purposes

SEC. 301. The provisions of this title shall be operative only during the existence of a state of civil defense emergency. The existence of such emergency may be proclaimed by the President or by concurrent resolution of the Congress. Such emergency also shall exist with respect to any designated geographic area of the United States when the President determines that any attack has been made upon or is anticipated within such area. Any such emergency shall terminate upon the proclamation of the termination thereof by the President, or the passage by the Congress of a concurrent resolution.

Utilization of Federal Departments and Agencies

SEC. 302. During the period of such emergency, under such terms as to donation, compensation, or return as may be prescribed, and solely for civil defense purposes, the President may direct, after taking into consideration the military requirements of the Department of Defense, any federal department or agency to provide, and such departments and agencies are hereby authorized to provide—

(*a*) Their personnel, materials, and facilities to the administrator for the aid of the states;

(*b*) Emergency shelter by construction or otherwise; and

(*c*) On public or private lands, protective and other work essential for the preservation of life and property, for clearing debris and for making emergency repairs to, and temporary replacement of, communications, hospitals, utilities, transportation facilities, or public facilities of states or their political subdivisions damaged or destroyed by attack.

Emergency Powers

SEC. 303. During the period of such emergency, the administrator is authorized to—

(*a*) Exercise the authority contained in section 201 (*h*) without regard to the limitation of any existing law;

(*b*) Sell, lease, lend, transfer, or deliver materials or perform services for civil defense purposes on such terms and conditions as the administrator shall prescribe and without regard to the limitations of existing law: *Provided,* That any funds received from the sale of materials or for services shall be deposited to the credit for appropriations currently available and made pursuant to this act and shall be available for expenditure for the purposes of such appropriations;

(*c*) Coordinate and direct, for civil defense purposes, the relief activities of the various departments and agencies of the United States as provided in section 302 hereof;

(*d*) Reimburse any state, including any political subdivisions thereof, for the compensation paid to and the transportation, subsistence, and maintenance expenses of any employees while engaged in rendering civil defense aid outside the state and to pay fair and reasonable compensation for the materials of the state government or any political subdivision utilized or consumed outside of the state, including any transportation costs, in accordance with regulations prescribed by the administrator. As used in this subsection, the term "employees" shall include full- or part-time paid, volunteer, auxiliary, and civil defense workers subject to the order or control of a state government or any political subdivision thereof, and such employees shall not be deemed by reason of such reimbursement to be employees or appointees of the United States;

(*e*) Provide financial assistance for the temporary relief or aid of any civilian injured or in want as the result of any attack; and

(*f*) Employ temporarily additional personnel without regard to the civil-service laws and to incur such obligations on behalf of the United States as may be required to meet the civil defense requirements of an attack or of an anticipated attack.

During the period of any such emergency, the administrator shall transmit quarterly to the Congress a detailed report concerning all action taken pursuant to this section.

Immunity from Suit

SEC. 304. The federal government shall not be liable for any damage to property or for any death or personal injury occuring directly or indirectly as a result of the performance of, or failure to perform, any function by any federal agency or employee of the government, in carrying out the provisions of this title during the period of such emergency. Nothing contained in this section shall affect the right of any person to receive any benefit to which he might otherwise be entitled under the federal Employees' Compensation Act, or any other act of Congress providing for any pension or retirement.

Termination

SEC. 307. The provisions of this title shall terminate on June 30, 1954, or on such earlier date as may be prescribed by concurrent resolution of Congress.

TITLE IV—GENERAL PROVISIONS

Administrative Authority

SEC. 401. For the purpose of carrying out his duties under this act, the administrator is authorized to—

(*a*) Employ civilian personnel for duty in the United States, including the District of Columbia, or elsewhere, subject to the civil-service laws, and to fix the compensation of such personnel in accordance with the Classification Act of 1949, as amended; and to place not more than twenty-two positions in grades 16, 17, 18 of the General Schedule established by that act, and any such positions shall be additional to the number authorized by section 505 of that act; and, notwithstanding the provisions of any other law, except those imposing restrictions upon dual compensation, employ, in a civilian capacity, with the approval of the President, not to exceed twenty-five retired personnel of the armed services on a full- or part-time basis without loss or reduction of or prejudice to their retired status;

(*b*) Employ not more than one hundred such part-time or temporary advisory personnel (including not to exceed twenty-five subjects of the United Kingdom and the Dominion of Canada) as are deemed necessary in carrying out the provisions of this act. Persons holding other offices or positions under the United States for which they receive compensation, while serving as members of such committees, shall receive no additional compensation for such service. Other members of such committees and other part-time or temporary advisory personnel so employed may serve without compensation or may receive compensation at a rate not to exceed $50 for each day of service, as determined by the administrator;

(*c*) Utilize the services of federal agencies and, with the consent of any state or local government, utilize the services of state and local civil agencies; establish and utilize such regional and other offices as may be necessary; utilize such voluntary and uncompensated services by individuals or organizations as may be needed; and authorize the states to organize such individuals and organizations into units to be known collectively as the United States Civil Defense Corps: *Provided*, That the members of such corps shall not be deemed by reason of such membership to be appointees or employees of the United States;

(*d*) Notwithstanding any other provisions of law, accept gifts of supplies, equipment, and facilities; and utilize or distribute same for civil defense purposes in accordance with the provisions of this act;

(*e*) Reimburse any federal agency for any of its expenditures or for compensation of its personnel and utilization of its materials and facilities under this act to the extent funds are available;

(*f*) Purchase such printing, binding, and blank-book work from public, commercial, or private printing establishments or binderies as he may deem necessary upon orders placed by the Public Printer or upon waivers issued in accordance with section 12 of the Printing Act approved January 12, 1895, as amended; and

(*g*) Prescribe such rules and regulations as may be necessary to carry out any of the provisions of this act, and, without being relieved of his responsibility therefor, perform any of the powers and duties vested in him through or with the aid of such officials of the administration as he may designate.

Security Regulations

SEC. 403. (a) The administrator shall establish such security requirements including restrictions or access to information and property as he deems necessary. No employee of the administration shall be permitted to have access to restricted information or property until it shall have been determined that no information is contained in the files of the Federal Bureau of Investigation or any other investigative agency of the government indicating that such employee is of questionable loyalty for security purposes, or if any such information is so disclosed, until the Federal Bureau of Investigation shall have conducted a full field investigation concerning such person and a report thereon shall have been evaluated in writing by the administrator. No such employee shall occupy any position determined by the administrator to be of critical importance from the standpoint of national security until a full field investigation concerning such employee shall have been conducted by the Civil Service Commission and a report thereon shall have been evaluated in writing by the administrator. In the event such full field investigation by the Civil Service Commission develops any data reflecting that such applicant for a position of critical importance is of questionable loyalty for security purposes, or if the administrator for any other reason shall deem it to be advisable, such investigation shall be discontinued and a report thereon shall be referred to the administrator for his evaluation in writing. Thereafter the administrator may refer the matter to the Federal Bureau of Investigation for the conduct of a full field investigation by such bureau. The result of such latter investigation by such bureau shall be furnished to the administrator for his action.

(*b*) Each federal employee of the administration, except the subjects of the United Kingdom and the Dominion of Canada specified in section 401 (*b*) of this act, shall execute the loyalty oath or appointment affidavits prescribed by the Civil Service Commission. Each person other than a federal employee who is appointed to serve in a state or local organization for civil defense shall, before entering upon his duties, take an oath in writing before a person authorized to administer oaths, which oath shall be substantially as follows:

"I, ——, do solemnly swear (or affirm) that I will support and defend the Constitution of the United States against all enemies, foreign and domestic; that I will bear true faith and allegiance to the same; that I take this obligation freely, without any mental reservation or purpose of evasion; and that I will well and faithfully discharge the duties upon which I am about to enter.

"And I do further swear (or affirm) that I do not advocate, nor am I a member or an affiliate of any organization, group, or combination of persons that advocates the overthrow of the government of the United States by force or violence; and that during such time as I am a member of the (name of civil defense organization), I will not advocate nor become a member or an affiliate of any organization, group, or combination of persons that advocates the overthrow of the government of the United States by force or violence."

Any person who shall be found guilty of having falsely taken such oath shall be punished as provided in 18 U.S.C. 1621.

Transfers to Administration

SEC. 404. The functions, property, and personnel of the federal Civil Defense Administration established by Executive Order 10186 (December 1, 1950), are hereby transferred to the administration established by this act, and the President may transfer to the administration such functions, property, and personnel of the National Security Resources Board concerned with civil defense activities as he deems necessary to carry out the purposes of this act.

Utilization of Existing Facilities

SEC. 405. In performing his duties, the administrator shall (1) cooperate with the

various departments and agencies of the government; (2) utilize to the maximum extent the existing facilities and resources of the federal government and, with their consent, the facilities and resources of the states and local political subdivisions thereof, and of other organizations and agencies; and (3) refrain from engaging in any activity which would duplicate activity of any other federal department unless the administrator, with the written approval of the President, shall determine that such duplication is necessary.

Annual Report to Congress

SEC. 406. The administrator shall annually submit a written report to the President and the Congress covering expenditures, contributions, work, and accomplishments accompanied by recommendations.

Appropriations and Transfers of Funds

SEC. 408. There are hereby authorized to be appropriated such amounts as may be necessary to carry out the provisions of this act. Funds may be allocated or transferred for any of the purposes of this act, with the approval of the Bureau of the Budget, to any agency or government corporation designated to assist in carrying out this act: *Provided*, That each such allocation or transfer shall be reported in detail to the Congress within thirty days.

Reconstruction Finance Corporation

SEC. 409. The administrator is authorized to certify to the Reconstruction Finance Corporation as to the necessity under its Civil Defense Program of purchasing securities or making a loan or loans for the purpose of aiding in financing projects for civil defense purposes, and the Reconstruction Finance Corporation is authorized to purchase such securities or to make such loans with maturities not to exceed fifty years and on such terms as the corporation may determine, except that any such purchases of securities or loans may be made only to the extent that financing is not otherwise available on reasonable terms. The total amount of loans, purchases, participations, and guarantees, made pursuant to this section shall not exceed $250,000,000 outstanding at any one time. The total amount of investments, loans, purchases, and commitments authorized by law to be made by the Reconstruction Finance Corporation is hereby increased by such sum.

Atomic Energy Act of 1946

SEC. 410. Nothing in this act shall be construed to amend or modify the provisions of the Atomic Energy Act of 1946, as amended.

Federal Bureau of Investigation

SEC. 411. Nothing in this act shall be construed to authorize investigations of espionage, sabotage, or subversive acts by any persons other than personnel of the Federal Bureau of Investigation.

NEWS IN BRIEF

Prepared by PETER AXEL

WEAPON TESTS BEGUN IN NEW TESTING AREA

Part of a 5,000-square-mile air force bombing range near Las Vegas, Nevada, has been made available to the AEC for atomic weapons testing. The first of the test explosions occurred there on January 27. The light generated by the burst was so brilliant that residents of Southern Utah, scores of miles away, saw the flash. This was the first nuclear explosion to take place in this country since the Alamogordo test in July, 1945.

No explicit information as to the nature of the planned experiments has been released, except for the implication that A-bombs, rather than H-bombs, would be tested. The commission's announcement, on January 11, said: "The use of the Las Vegas Bombing and Gunnery Range will make available to the Los Alamos Scientific Laboratory a readily accessible site for periodic test work with a resultant speed-up in the weapons development program. Test activities at the new site will include experimental nuclear detonation for the development of atomic bombs – so-called 'A-bomb' – carried out under controlled conditions. . . . The commission will continue to use the Eniwetok Proving Ground in the Marshall Islands."

The Atomic Energy Commission further indicated that: "Safety conditions are such that tests will not interfere with the air force training programs at the base. Radiological safety and security conditions incident to the type of test to be undertaken have been carefully reviewed by authorities in the fields involved."

AEC APPROPRIATIONS

The Atomic Energy Commission received its additional appropriation for the current fiscal year when President Truman signed the 20 billion dollar emergency appropriations bill on January 6. The bill assigned 1.065 billion dollars to the AEC; this was 15 million dollars more than the administration had originally requested.

In his annual budget message on January 15, President Truman asked for $1.277 billion for the Atomic Energy Commission for next year. This sum, which represents about a 50 per cent increase over the regular appropriation last year, will be used by the AEC to enlarge its "production capacity for atomic materials and weapons."

AEC EXPANSION

The principal construction contractor for the new uranium-235 production plant at Paducah, Kentucky, will be the F. H. McGraw Company of Hartford, Connecticut. The construction phase will require $350 million of the $500 million budget for the Paducah facilities. The McGraw Company will build all the structures at the site, including process buildings, supporting service facilities, and administrative buildings, and will instal production equipment.

Three architect-engineering firms selected for work at the Paducah plant are:

Giffels and Vallet, Inc., Detroit, for preliminary engineering and design of the process plant and inspection of its construction; Sargent and Lundy, Chicago, for the design and inspection of power facilities; and Smith, Hinchman, and Grylls, Inc., Detroit, for specialized design and engineering for sanitary and fire water systems, sewer system and treatment plant, steam plant, and administrative and auxiliary buildings.

The power for the new uranium-235 plant will be supplied jointly by the Tennessee Valley Authority and Electric Energy, Inc., a syndicate of five privately owned public utility firms. The TVA will build a steam electric power plant on the Kentucky side of the Ohio River, fifteen miles northwest of Paducah. The plant will have four generating units, each with a capacity of 150,000 kilowatts. The TVA will build a similar steam plant at Kingston, Tennessee. Electric Energy, Inc. will construct a $73,000,000 plant near Joppa, Illinois, which will have a capacity of 500,000 kilowatts.

The generating and distribution systems of both TVA and the five private companies will be so interconnected as to provide for the use of the total power resources of all systems and to permit economic interchange of power to utilize periodic surplus power from the new generating stations. The five companies in Electric Energy, Inc., are: Central Illinois Public Service, Illinois Power Company, Middle South Utilities, Inc., Kentucky Utilities Company, and Union Electric Company of Missouri.

LAND REFORM IN KOREA

A recent report from George Barrett, *New York Times* correspondent in Pusan, Korea, published in the *Times*, January 24, notes that the U.S. Economic Cooperation Administration officials are making a special effort to get the South Korean government to enforce the law abolishing absentee landlordism, which was voted a year ago.

The big landlords have made every effort to hold up the reform; they have been aided in their obstruction by the fact that many of the papers required to carry out transfers of deeds were burned by the North Koreans when they marched into the South. The ECA officials are maintaining pressure to continue the program, allowing the paper work to catch up later. The South Korean farmers are using last fall's crops to pay their first installments on pay-as-you-go contracts which will give them complete titles in five years' time. If it were not for the war, the officials say, the South Korean land reform would be virtually completed now. Though still in need of better enforcement, the program is declared to be far superior to the reform carried out by the Communists in North Korea.

"The ECA aides, some of whom not only talked with scores of farmers in North Korea when the United States armies advanced into that territory, but also conferred with communist officials who had helped to administer the North Korean land reform, declared categorically that every farmer consulted was as opposed to the communist arrangements as they had been to the old absentee landlordism.

"The Communists, with a wise flair for swift action, parceled out property among tenant farmers apparently on a democratic basis, and it was not until some time later that the land was reapportioned to give the communist supporters choice sections.

"As time went on and special taxes kept piling up, according to the ECA officials, farmers soon discovered that what they had left—with theoretical ownership of their land—was much less than what they ever had had before."

This report substantiates what was said about the ECA program by Dr. Clyde Mitchell, writing in the December issue of the *Bulletin*.

NEW CANADIAN PILE

A plan to build a new 30-million-dollar atomic pile at Chalk River, Ontario, was announced by the Canadian Trade Minister C. D. Howe on January 2. Although the proposal has not yet been submitted to Parliament, approval is considered certain. The new pile, "many times more powerful" than the one already in use there will be both a commercial and a research project. The sale of the plutonium (presumably to the U. S.) and radioisotopes is expected eventually to put Chalk River on a paying basis. The neutron flux to be attained from the new heavy water moderated reactor, was not indicated; the maximum flux from the present large pile at Chalk River, 5.7×10^{13} neutrons/ sq. cm./ sec., is the largest known in the world. Mr. Howe said that the new development will enable Canada to tackle the vital problems in atomic development concerned with "breeding" fissionable material and designing commercial atomic power plants.

FRENCH ATOMIC ENERGY COMMISSION

Francis Perrin, former member of the French AEC, was appointed to succeed Frederic Joliot-Curie, who was removed last April from his post as high commissioner because of his associations with the Communists. M. Perrin is professor of atomic and molecular theory at the College of France and is the son of the noted scientist, Jean Perrin.

Additional changes in the personnel of the French commission included the dropping of Mme. Irene Joliot-Curie and the appointment of an advisory scientific council. The advisory group includes: Duc Maurice de Broglie, Prince Louis de Broglie, Professor Pierre Auger, Louis Bugnard (director of the National Hygiene center), Professor Georges Chandron, and Professor Maurice Roy.

ATOM SPIES IN CZECHOSLOVAKIA

A former French Embassy clerk in Czechoslovakia was sentenced to twenty-five years in prison on December 27, 1950, for spying on Czechoslovakia's uranium mines and trying to smuggle samples of ore out of the country. Gervais Garcette was convicted of giving nine pounds of uranium ore and reports on Czech uranium production to French military attaché Georges Helliot. Two Czechs, Gustav Maran and Oldrich Adamek, who were his accomplices, were sentenced to death and twenty years, respectively.

EUGENE GARDNER—ATOMIC CASUALTY

Dr. Eugene Gardner, nuclear physicist of the University of California, died on November 26 as a result of beryllium poisoning incurred during his work on the wartime atomic bomb project. Dr. Gardner was exposed to the non-radioactive poisoning during 1941–43 when he was working with beryllium ceramics at the radiation laboratory of the university at Berkeley. Two years ago, Dr. Gardner was the co-discoverer of the first artificially produced mesons. For the last six months, although he was an invalid, he kept a microscope near his oxygen tent and studied meson tracks in emulsions whenever he was permitted out of bed. Dr. Gardner, who was thirty-seven, had a wife and two-year-old daughter.

The California State Compensation Insurance Commission approved payment of $7,500 to Dr. Gardner's widow on December 14.

Dr. Howard Fidler, area director of the AEC, said that the AEC is considering approval of an additional unspecified award to Mrs. Gardner.

DECLASSIFICATION

A working subcommittee of four representatives of technical societies has made suggestions to the AEC concerning specific classified material which would be of use to industry. The subcommittee's survey indicated that most of the noteworthy information is in the fields of chemical and metallurgical engineering, although there are also contributions to mechanical and electrical engineering. The subcommittee consisted of E. E. Thum (chairman), editor, *Metal Progress*, and representative of the American Society for Metals; Keith Henney, editor, *Nucleonics*, and representative of the Institute of Radio Engineers; S. A. Tucker, editorial director, American Society of Mechanical Engineers; and F. J. Van Antwerpen, editor, *Chemical Engineering Progress* and representative of the American Institute of Chemical Engineers.

The group, which began work in July 1949, has examined the documents in the patent department and has studied the Y-12 plant at Oak Ridge. While a large number of recommendations were made, "the declassification of information by the AEC was found to be satisfactory." The members stated that "in no case have we uncovered any 'huge amount' of secret information of value to industry, although some specific cases of valuable information are quoted in our reports." The brief summary of the findings to date was released by the AEC on January 17; the more detailed recommendations, which had been made by the individual members, are being implemented by the AEC.

BRITISH ATOMIC SCIENTISTS' ASSOCIATION

The Council of the British Atomic Scientists' Association has appointed Professor N. F. Mott as president for the year 1951, succeeding Professor Peierls.

QUOTES

Winston Churchill (in a speech to the House of Commons on December 14, 1950):

"It is only the vast superiority of the United States in this awful weapon that gives us any chance for survival. The argument is now put forward that we must never use the atomic bomb unless it has been used against us first. In other words, you must never fire until you have been shot dead. That seems to me undoubtedly a silly thing to say and a still more imprudent position to adopt.

"Moreover, such a resolve would certainly bring war nearer. The deterrent effect of the atom bomb is at the present time almost our sole defense. Its potential use is the only lever by which we can hope to attain reasonable consideration in an attempt to make a peaceful settlement with Russia."

Grand Soviet Encyclopedia (released in Moscow on December 22, 1950):

"The explosions at Hiroshima and Nagasaki caused not so much military destruction as the annihilation of several thousand civilians due to the explosion as well as radioactivity in the human organism. Thus, American propaganda affirming that the atomic bomb can replace other weapons and decide the outcome of war is untenable."

Dr. Shields Warren (at AEC press conference on January 2, 1951):

"We are finding an increased incidence of cataracts in those survivors who had been within the zone where they were exposed to neutrons. There were some 71 well-recognized cases found among approximately 1,000 survivors studied."

Scientific Manpower Mobilization

(*Continued from page 42*)

"2. During the first three years of the UMST program, the President could temporarily suspend the draft service of up to 75,000 men reaching 18 each year so they could continue their college training. Like the ROTC students, they'd have to take their four months' basic first.

"These youths would be selected on general qualities of 'intellect and leadership' by boards of civilian experts and given higher education in various fields necessary to the national welfare. An adequate flow of scientists, doctors, and other leaders is aimed at under this plan. It is contemplated that national scholarships would be available to enable outstanding youths without means to be chosen.

"After the first three years, an adequate flow of men through college could be assured by men leaving the service after their 27 months in uniform, Mrs. Rosenberg said, and the special deferments would stop. After graduation those who had not discharged their full military obligation could be called.

"3. Even after graduation, doctors, scientists, and other technicians could be deferred by the President if the national interest demands. If not called within ten years, they would be no longer obligated under UMST.

"4. The bill would allow 18-year-olds to graduate from high school before being called for training, if they could graduate before or shortly after their nineteenth birthday. Similarly, youths who enter college before they are 18 would not be inducted until the end of the college year, and those enrolled for a college year before being ordered up for induction, even if of draft age, when enrolled could finish out the year."

In an editorial published in *Science* on January 19, Mr. Wadsworth Likely commented as follows:

"What is now emerging, and what Congress is likely to accept, is a compromise of the two plans [the Trytten report and the Conant proposals]. The final product will recognize both the cold hard facts on which the Trytten proposals were based and the political appeal of the Conant plan. . . .

"The essence of the compromise is that qualified men shall be sent back to college once they have been drafted. It is due to the work of Dr. Trytten and his committees that there is such a wide acceptance of the necessity for such a step. Most important, the unanimous report of the Thomas Committee demonstrates that it has support from two proponents of all-out service who are members of the committee—Vannevar Bush and Gordon Gray, president of the University of North Carolina.

"The second Trytten principle—that the student should be allowed to choose what he shall study—has also fallen by the wayside. But, once again, it is likely that, because of the Trytten report, the widest possible interpretation of what is 'essential' will be made.

"Pulling and hauling now will take place on two issues: (*a*) By what method shall these boys be returned to college? (*b*) Who shall decide what they will study? Former proponents of the Trytten plan will probably want qualified boys, furloughed immediately after induction, to go to colleges of their choice, and a civilian board to decide essential fields of training and see to it that they keep up in their marks. The other extreme is that the boys be members of military units established on college campuses, and that their lives and what they study be strictly regulated by the Defense Department.

"It is expected that, either in the new draft law or in the hearings during which the law is written, the intent of Congress that provisions must be made for scientific, technical, and engineering training will be enunciated. Congress will also have to face the problem of utilization of scientific, technical, and engineering personnel already trained. Most plans—and there have been many—visualize compulsory registration of scientific manpower and machinery to place that manpower where it is needed, and to determine how far down in the educational scale such registration should go, and whether placement power should be restricted to the needs of the military or spread over our whole economy. There are few clues as to the thinking of Congress, but the Gurney Bill, under which some doctors can be drafted, may set the precedent."

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